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April 1980

Tropical Timbers of the World



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TROPICAL TIMBERS OF THE WORLD *JFC*

By

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U.S. Forest Products Laboratory
Tropical timbers of the world, by Martin Chudnoff.
Madison, Wis., Forest Prod. Lab., For. Serv., USDA,
1979. 831 p.

As an aid in better utilization of the world's timbers, information from many sources has been compiled, evaluated, and interpreted to a common basis. While only a portion of the world's myriad species are included, this standardized presentation provides much help for the user that needs a quick and ready reference.

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 Madison, Wis., by the Forest Service,
 U.S. Department of Agriculture, in
 cooperation with the University of Wisconsin

ABSTRACT

This volume contains a description of tropical trees and their timbers grouped according to regional origin: tropical America, Africa, and southeast Asia and Oceania. Part I contains standardized single-sheet descriptions with emphasis on physical and mechanical properties, processing characteristics, and uses for the woods of 370 species or generic groupings. Data are compiled from the world literature. Part II contains a coding of the technical data that permits easy comparison of species properties and selection of woods most suitable for particular end-uses.

ACKNOWLEDGMENT

Sincere thanks are due to Dr. Robert C. Koeppen of the Forest Products Laboratory, Center for Wood Anatomy, for review of the technical data and nomenclature in this work.

TROPICAL TIMBERS OF THE WORLD

By

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INTRODUCTION

Over the past two decades U.S. lumber imports from the tropics have increased fourfold. Plywood trade, mostly from Asian sources, has soared fortyfold and now equals our domestic production. Log imports, though, have decreased drastically from about 100 million board feet (log scale) in the 1950's to 30 million currently. Much of the world timber trade now is in the form of processed material. Many more tropical wood species and species groupings are being made available to U.S. processors. Most of these have been well known for many years on the European markets. This interest in supplemental supplies from overseas is in both softwoods and hardwoods.

An extensive foreign literature has described the properties and uses of tropical woods, but much of it is no longer readily available. In this country the U.S. Forest Products Laboratory, over the years, issued "Information Leaflets" or "Foreign Wood Series" reports on some species of importance. But many of these are now out of print. The most recent comprehensive document, "Properties of Imported Tropical Woods,"^{1/} contained a description of about 100 tropical genera.

Because of the ever-increasing demand for reference material, we have now prepared this more extensive data source. Part I contains cryptic single-sheet descriptions of tree and timber characteristics for about 370 species or generic groupings (the actual number of botanical entities is much more). See figure 1 for format of the descriptions. Almost all the information was compiled from world literature. This required an extensive search of abstracts and then an amassing of a rather formidable documentation. Many of these data are focused on species already highly favored in world trade.

^{1/} Kukachka, B. F. 1970. Properties of imported tropical woods. U.S. Dep. Agric. For. Serv. Res. Pap. FPL 125. For. Prod. Lab., Madison, Wis.

Front

NAME _____

Family:

OTHER COMMON NAMES:

DISTRIBUTION:

THE TREE:

THE WOOD:

GENERAL CHARACTERISTICS:

WEIGHT:

MECHANICAL PROPERTIES:

Moisture Content	Bending Strength lb/in ²	Modulus of Elasticity 1000 lb/in ²	Maximum Crushing Strength lb/in ²

DRYING AND SHRINKAGE:

WORKING PROPERTIES:

Back

DURABILITY:

PRESERVATION:

USLS:

ADDITIONAL READING:

Figure 1.--General form of the information sheet used for each of the woods.

To fit the single-sheet format (fig. 1) worldwide information had to be translated, interpreted, reduced, and synthesized. A small part is based on research conducted by the U.S. Forest Service.

Species are listed alphabetically by scientific name and are grouped according to regional origin--Tropical America (AM), Africa (AF), and Southeast Asia and Oceania (AS).

Technical data and descriptive information presented in Part I follow the format used by R. H. Farmer.^{2/}

Part I, then, is the basic reference and supplies condensed information about a particular species or species grouping. Part II assists in selecting a timber that has a desired set of attributes and facilitates access to information contained in Part I.

Part II classifies the physical and mechanical property data into groupings that permit species comparisons even though methods of testing may have been quite different. A guide to several major use categories is also included. All data are presented in table form that allows rapid scanning or easy transfer to card sorts or input to a computer retrieval system. A summary reference sheet can be used to decode physical and mechanical properties classified in table II-I.

Six appendixes supply additional information. Appendix A is a partial list of selected forest products references, almost all of which were used in this compilation. They are divided into those with worldwide coverage and those specific to Tropical America, Africa, and Southeast Asia.

If only the trade name of a wood is known, then appendix B can be used to obtain cross references to scientific names and thus entry to the data sheets. Space does not permit a listing of the thousands of common names used in the producing countries.

Appendix C is a list of generic synonyms. If a particular species or species grouping cannot be found in the text, this list of name changes should be checked.

Appendix D may be helpful where more than one genus makes up a trade grouping. For example, the name Neesia may be known, but the data sheet is filed Durio and Neesia.

Appendix E furnishes information on the derivation of comparable toughness values given in table II-1.

^{2/} Farmer, R. H. (Editor). 1972. Handbook of hardwoods. H. M. Stationery Office, London.

Part I

Data Sheets

PART I--DATA SHEETS

Explanation of Headings

Scientific Names

Data sheets are arranged alphabetically by generic name within the three main tropical regions. Where more than one species is described within a genus, the material is presented alphabetically according to specific name or group trade name. Where two or more species in a genus make up a commercial grouping, the composite is designated by spp., e.g., Peltogyne spp.

We have attempted to use currently accepted nomenclature but, where the synonym is well known it is also given. For example: Ochroma pyramidale SYN. Ochroma lagopus or Nauclea diderrichii SYN. Sarcocephalus diderrichii. Some commercial timber groupings may include more than one genus. For example, the wood marketed as "Resak" includes Cotylelobium spp. and Vatica spp.

Many genera are native to more than one region (Podocarpus, Pterocarpus, Terminalia), but Ceiba pentandra and Symponia globulifera are the only species listed that are indigenous to two regions. Their tree and wood characteristics are described in both the American and African sections using appropriate reference material. However, many species from one region have been introduced into the other two, either as ornamentals or for the production of such products as timber, tannin, latex, and gums and resins. Hevea brasiliensis (Para rubber tree) is native to Brazil but is most extensively cultivated in Africa and Asia. Tectona grandis (teak) is a favored plantation species in tropical America and West Africa but is native to Southeast Asia. The data sheets for these and other exotics are filed in their region of origin.

To further complete botanical affinities, family names are also given. Plants developing woody tissue are classified in about 150 families. Species and species groupings in this compilation can be placed in some 70 families. The largest number, by far, is in the Leguminosae, followed by Meliaceae, Lauraceae, and Moraceae. There are also four gymnosperm or conifer families (Araucariaceae, Cupressaceae, Pinaceae, and Podocarpaceae) with descriptions of 19 species or species groupings.

Trade and Other Common Names

The scientific name is followed by one or more trade names. These come into use after years of marketing on national and international levels. Sometimes the trade name is merely a repetition of the generic name, e.g., afzelia, albizzia, alstonia. Often when there is a superficial similarity to a Temperate Zone timber (but not a botanical affinity), names such as "Queensland-maple" and "silky-oak" are used. Honduras mahogany is a trade name for Swietenia macrophylla because shipments, at first, were mostly centered in that region. Yet the name applies to timber now harvested from Mexico southward to eastern Bolivia. The name "mahogany," with a geographical modifier, also refers to species of Khaya from Africa and to botanically unrelated species of Shorea from the Philippines.

A few other common names, mostly of local use only, are also given. Some woods may have dozens of such names, changing from country to country and from district to district within countries. All of the trade names, but only a few of the common names, are indexed in this volume.

Distribution

Information on growth ranges and site preferences is given. Gregarious species are also noted. Most of the species or species groups described here are found growing between the Tropic of Cancer and Tropic of Capricorn, some 50° of latitude. Included are a few species growing outside of the tropical belt, e.g., Nothofagus spp. and Fitzroya cupressoides native to Chile and Argentina and some eucalypts from Australia.

Most of the species described are available to world markets only in rather small volumes. To obtain larger supplies for a particular end-use, it may be necessary to accumulate timbers having similar characteristics from several botanical groupings. Even those species growing in pure stands over large areas may be limited in supply. For example, Parana-pine forests have been heavily cut over in Brazil, and the area is being restocked mainly with exotics. Virola spp., once abundant in the Guianas, must be imported from other regions in order to meet local veneer needs. Okoume, a highly favored plywood species on the European market, is no longer available from the "First Zone" (mostly coastal) of Gabon. Because of this transient characteristic of the resource, we have not attempted to indicate current or future availability of the species listed.

Distribution within the tropics is highly variable. Some species are found in coastal tidelands (red mangrove, Rhizophora mangle); swamp

forests (ramin, Gonystylus bancanus or banak, Virola spp.); on low coastal plains and along riverbanks (cativo, Prioria copaifera or mora, Mora excelsa). Others are established on low-temperature high-mountain sites (roble, Quercus spp. or Benquet pine, Pinus insularis). All of the above species occur in rather pure forest stands. Where there are no unusual atmospheric, geological, topographic, or edaphic conditions, the most common species found in lowland tropical forests seldom makes up 10 percent of the volume, often much less.

The Tree

Tree form and size are emphasized under this heading. Some specialty woods are milled from very small stems (African blackwood, Dalbergia melanoxylon or West Indian satinwood, Zanthoxylum flavum). Other timbers come from trees that soar to heights of 150 to 200 feet and have log diameters of 8 feet and more (okoume, Aucoumea klaineana or kapur, Dryobalanops spp.).

Trunks of many species have buttresses that may reach heights of 15 to 25 feet (obeche, Triplochiton scleroxylon or mora, Mora spp.). Those having bark covered with large conical spines (hura, Hura crepitans, or ceiba, Ceiba pentandra) are also noted.

The Wood

Emphasis in this compilation is on wood characteristics, processing properties, and uses.

General Characteristics

Stress here is on appearance. Heartwood colorations, unusual changes on exposure to light or air, and differentiation, if any, from sapwood are described. Woods with high luster or golden cast due to the way light is reflected are noted. If anatomical elements are large and irregular, the wood is described as having coarse and uneven texture. If these same features are small and evenly distributed, the texture is fine and uniform. Grain defines the arrangement or alignment of wood tissue--straight, spiral, or interlocked. Interlocked grain is most common in tropical timbers and is due to an alternating right- and left-hand spiraling of the grain. If quartersawn, this produces a ribbon or roey figure. Other grain irregularities, enhanced by various sawing or slicing techniques, can develop other kinds of figure, e.g., curly, feather, fiddleback, etc. Distinctive scents

and taste are also noted. Silica percentages, if significant, are given. The literature suggests that there is little blunting of cutting tools unless silica accumulations are above 0.5 percent.

Almost all woods have constituents that are allergenic or toxic to someone, including our native white pine and paper birch. Most people, though, are unaffected by most woods. Dust generated in woodworking may irritate skin and mucous membranes and even cause nosebleed and respiratory disorders. Timbers that are particularly toxic are noted. Woods with gummy, oily, or resinous exudates are also indicated.

Weight

Specific gravity or density may be related to important wood attributes such as mechanical strength, shrinkage, paper-forming properties, and cutting forces required in machining. Often in assessing the use potential of a species, specific gravity is a characteristic that receives first attention.

Basic specific gravity is the ratio of wood density to the density of water at 4° C and is calculated from the ovendry weight and volume in the green condition. This may range from less than 0.1 (balsa, *Ochroma pyramidalis*) to about 1.1 (*lignumvitae*, *Guaiacum* spp.). Density calculated from weight and volume when airdry, usually at a moisture content of 12 percent, is also given. This may range from about 10 to 80 pounds per cubic foot (pcf) for commercial species.

Mechanical Properties

Data are given for strength tests in the green and dry condition. These include bending strength (modulus of rupture), stiffness in bending (modulus of elasticity), compression parallel to the grain (maximum crushing strength), Janka side hardness, and toughness (based on either the Amsler or the FPL-Madison type machines).

Most test results reported here are based on the ASTM D 143 procedures using either 2-inch or 1-inch specimens, British Standard No. 373 using 2-centimeter material, or Norme Francaise B51-007, B51-008, etc., also a 2-centimeter standard. In the French data, modulus of rupture was calculated using beam depth to the 10/6 power instead of the square of the depth used to obtain U.S. and British bending strength values. The data based on French standards were adjusted to be comparable in this presentation. There are other differences in testing methods. At the Instituto de Pesquisas Tecnologicas, Sao Paulo, bending strength is based on beams 2 by 2 by 30 centimeters, center-loaded over a 24-centimeter span. Modulus of elasticity, though, is calculated from test beams 6 by 6 by 100 centimeters, center-loaded over a 84-centimeter span.

It must be emphasized that the mechanical properties presented are taken from the world literature. Sampling and testing procedures have varied considerably. Values are given so that comparisons between species can be made as well as selection for targeted end uses. However, the data reported may not be acceptable to regulatory bodies as a basis for assigning design properties. Such interests are beyond the scope and intent of this document.

Drying and Shrinkage

Note is made of response to air drying and kiln drying and whether or not there is degrade due to checking, warp, or collapse. Kiln schedules, based on available literature, are also suggested for 4/4 and 8/4 stock (nominal 1- and 2-in. thickness). "Moisture content" schedules are coded to indicate desired dry-bulb temperatures, moisture content at step change, and wet-bulb depressions. For example, T6-D4 is suggested for 4/4 Honduras mahogany lumber. "T6" indicates the desired dry-bulb temperature settings, "D" the sample board moisture contents at which changes are made in the dry-bulb and wet-bulb settings, and "4", the wet-bulb depressions that accompany the dry-bulb temperatures. (See tables I-1 and I-2). These settings are assembled to form the working kiln schedule.

Example: T6-D4 Dry Kiln Schedule for Honduras Mahogany

<u>Moisture content at start of step (Pct)</u>	<u>Dry-bulb temperature (°F)</u>	<u>Wet-bulb depression (°F)</u>	<u>Wet-bulb temperature (°F)</u>
Above 50	120	7	113
50	120	10	110
40	120	15	105
35	120	25	95
30	130	40	90
25	140	50	90
20	150	50	100
15 to final	180	50	130

Occasionally the letter "S" follows a kiln schedule code, e.g., T10-D4S. This refers to general wet-bulb depression schedules for the softwoods or conifers (table I-3) and is sometimes suggested as well for drying particular hardwoods.

For further information on assembling kiln schedules references should be made to:

Rasmussen, E. F.

1961. Dry kiln operator's manual. U.S. Dep. Agric., Agric. Handb. No. 188.

Table I-1.--General temperature schedules for hardwoods and softwoods

Temperature step No.	Moisture content at start of step	Dry-bulb temperatures for temperature schedule No.													
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
Pct	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	
1	Above 30	100	100	110	110	120	120	130	130	140	140	150	160	170	180
	2	30	105	110	120	120	130	130	140	140	150	150	160	170	180
3	25	105	120	130	130	140	140	150	150	160	160	160	170	180	190
	4	20	115	130	140	140	150	150	160	160	160	170	170	180	190
5	15	120	150	160	180	160	180	160	180	160	180	180	180	190	200

Table I-2.--General wet-bulb depression schedules for hardwoods

Wet-bulb depression step No.	Moisture content at start of step for moisture content class					Wet-bulb depressions for wet- bulb depression schedule No.								
	A	B	C	D	E	F	1	2	3	4	5	6	7	8
1	Above 30	Above 35	Above 40	Above 50	Above 60	Above 70	3	4	5	7	10	15	20	25
2	30	35	40	50	60	70	4	5	7	10	14	20	30	35
3	25	30	35	40	50	60	6	8	11	15	20	30	40	50
4	20	25	30	35	40	50	10	14	19	25	35	50	50	50
5	15	20	25	30	35	40	25	30	35	40	50	50	50	50
6	10	15	20	25	30	35	50	50	50	50	50	50	50	50

Table I-3.--General wet-bulb depression schedules for softwoods

Wet-bulb depression step No.	Moisture content at start of step for moisture content class					Wet-bulb depressions for wet- bulb depression schedule No.								
	A	B	C	D	E	F	Pct	Pct	Pct	Pct	°F	°F	°F	°F
1	Above 30	Above 35	Above 40	Above 50	Above 60	Above 70	3	4	5	7	10	15	20	25
2	30	35	40	50	60	70	4	5	7	10	14	20	25	30
3	25	30	35	40	50	60	6	8	11	15	20	25	30	35
4	20	25	30	35	40	50	10	14	15	20	25	30	35	35
5	(1)	20	25	30	35	40	15	20	25	30	35	35	35	35
6	--	(1)	20	25	30	35	20	25	30	35	35	35	35	35
7	--	--	(1)	20	25	30	25	30	35	35	35	35	35	35
8	--	--	--	(1)	20	25	30	35	35	35	35	35	35	35
9	--	--	15	15	(1)	20	35	35	35	35	35	35	35	35
10	15	15	15	15	15	15	50	50	50	50	50	50	50	50

1/ Go directly to step 10.

Percent shrinkage values (volumetric, radial, tangential) from the green to ovendry condition or green to air-dry condition are given. Movement values indicate dimensional stability in service and are based on the sum of percent radial and percent tangential dimension changes corresponding to a change in exposure from 90 to 60 percent relative humidity. Ratings used are:

Small	Under 3 percent
Medium	3.0 to 4.5 percent
Large	Over 4.5 percent

Working Properties

Much of the information in this section is highly subjective. Described are ease of working with hand and machine tools, tendencies to torn or chipped grain, smoothness of finish cut, dulling of cutters, and ease of veneering. Nailing, screwing, or gluing characteristics may be included as well as steam-bending properties if well suited for this purpose. If working the wood is reputed to cause skin or mucous membrane irritations, this is mentioned again.

Durability

Resistance of the wood to attack by decay fungi, insects, and marine borers is described. Ratings are based on laboratory assays, field stake tests, or performance under actual use conditions.

Heartwood decay resistance classifications are based on ground contact and are:

<u>Classification</u> ^{2/}	<u>Approximate Service Life</u> (Yr)
Very durable	More than 25
Durable	15-25
Moderately durable	10-15
Nondurable	5-10
Perishable	Less than 5

Sapwood of all species will rate "perishable." If not in ground contact and kept dry, all woods could be free of rot and have an extended service life. Consideration though must also be given to vulnerability to attack by Lycus beetles, subterranean and dry-wood termites, and other insects. If data are available, resistance to such attack is reported. Weathering characteristics and performance under particular kinds of chemical exposure may also be noted.

Preservation

Treatability of sapwood and heartwood using either open tank or pressure-vacuum processes is described. Ratings may range from "permeable," where absorption of preservative solutions are 15 to 20 pcf and more with complete or deep chemical penetration, to "extremely resistant" if absorption is only 2 to 3 pcf or less and lateral penetration is superficial. There is no standard treatability test, and ratings may be based on laboratory trials using a wide range of specimen sizes, with or without end coatings, or actual commercial treating plant experience.

Uses

Suitability of a timber for particular applications may be based on indigenous uses in underdeveloped regions or perhaps long experience in export trade but with little or no experience on U.S. markets. As an example, Jongkong (Dactylocladus stenostachys) is treated with oil and used for shingles in Sarawak. This wood may not be marketable here for the same purpose. Demand exists overseas for woods particularly suitable for produce boxes, which are hardly now used in the U.S. economy. Nevertheless, the lists of uses indicate the properties and working characteristics of the wood and may suggest applications still not realized. Often trees formerly classified as uneconomic or as "weed" species are now in high demand on world markets. Use categories, then, should not be considered definitive.

If a tree is noted for the yield of products other than wood (gums, latex, fiber, tannins, nuts and fruits, etc.), this is also indicated.

Additional Reading

The species descriptions are based on a compilation of world literature. Presentations are rather concise to fit the single-sheet format. Material for a few species is based on only one or two sources; more often dozens were used. Usually three or four key references are cited. Sources for the strength data are always given.

A few thousand documents were consulted to develop this data base, most of them long out of print. For those with an interest to read further, a list of key references is given in appendix A.

Individual Data Sheets for

Species by Region of Origin:

Tropical America (AM)

ALEXA IMPERATRICIS

HAIARI

Family: Leguminosae

Other Common Names: Hiariballi (Guyana).

Distribution: Found in the Venezuelan Guiana, Guyana, Surinan, and the Brazilian Amazon region. Often dominant on the light-colored sands of the northwest and upper Mozaruni district and the Pakaraima Mountains in Guyana.

THE TREE Unbuttressed, well formed, with small oval crowns. Grows to 36 in. in diameter and 100 ft high on favorable sites, but are usually 20 to 24 in. in diameter and less than 100 ft high. The bole is cylindrical and often 70 ft long.

THE WOOD General Characteristics: Heartwood brownish yellow but occasionally somewhat darker; not sharply differentiated from the light yellow to grayish yellow sapwood, 3 to 4 in. wide. Luster is medium to low; generally straight grained; rather coarse textured; odorless and tasteless when dry.

Weight: Basic specific gravity (ovendry weight/green volume) reported to be 0.46 to 0.55 in Guyana; 0.41 in the Venezuelan Guiana. Air-dry density about 32 pcf.

Mechanical Properties: (1-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	10,590	1,580	5,620

Janka side hardness is 690 lb and the Forest Products Laboratory toughness is 118 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Lumber has a marked tendency to collapse during seasoning. Close piling for air drying and the use of high humidities and low temperatures during the early stages of kiln drying are suggested. Veneers are slow to dry. Jet drying of 1/16-in. veneer at 285° F resulted in buckling, collapse, and splitting. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 4.0%; tangential 8.5%; volumetric 11.7%. Movement of seasoned wood is classified as large.

Working Properties: Haiari is reported to work easily and finish satisfactorily. Nail withdrawal resistance is higher than would be expected from its density. Rotary cutting trials of 1/16-in. veneer gave smooth surfaces and uniform thickness; rough cutting occurred in 1/8-in. veneer. Reported to have rather unfavorable gluing properties when made into plywood.

Durability: Reported to be highly resistant to decay, but freshly cut logs are very susceptible to damage by pin-hole borers.

Preservation: Both sapwood and heartwood very easy to treat. Absorptions over 9pcf with uniform penetration obtainable by hot and cold bath as well as pressure-vacuum systems.

Uses: Haiari is suitable for interior construction, boxes, crating, general construction, plywood, and other uses requiring an easily worked wood of moderate strength.

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1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5.
2. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207, U.S. Department of Agriculture.
3. Slooten, H. J. van der.
1970. Forest industries development survey, Guyana. Evaluation study of eighteen wood species from Guyana for veneer and plywood manufacture. FAO Report FO: SF/GUY 9, Technical Report 13. Rome.

ANACARDIUM EXCELSUM

ESPAVE

Family: Anacardiaceae

Other Common Names: Espavel (Nicaragua), Caracoli (Venezuela, Colombia), Cajú assú, Cajú da matta (Brazil), Marañón (Ecuador).

Distribution: Costa Rica south through Panama to Colombia, Venezuela, and Ecuador. Frequently found in coastal areas on well-drained soils. Almost pure stands reported in the Darién Province of Panama.

THE TREE Commonly attains diameters of 3 to 5 ft, total height frequently ranges from 75 to 150 ft. Forest-grown trees often have clear boles 30 to 60 ft. Some basal swelling but no well-developed buttress.

THE WOOD General Characteristics: Heartwood on exposure becomes a fairly uniform russet brown with a golden or reddish cast; sapwood is 6 to 10 in. thick, grayish white with more or less pinkish tinge, sharply demarcated from heartwood. Wood has a fairly high luster and is attractively marked by prominent vessel lines; medium to coarse textured and typically has an interlocked grain with a pronounced stripe. Distinctive odor and taste are lacking.

Weight: Basic specific gravity (ovendry weight/green volume) 0.41; air-dry density 30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	5,320	1,060	2,460
12%	7,960	1,280	4,530

Janka side hardness 400 lb green and 470 lb for air-dry wood. Forest Products Laboratory toughness is 57 in.-lb average for green and air-dry material (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Espavé is described as moderately difficult to air dry. It has a somewhat variable drying rate with pieces drying quickly tending to warp and check. Kiln schedule T6-D2 is suggested for 4/4 stock and schedule T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.8%; tangential 5.2%; volumetric 8.4%.

Working Properties: Espavé is rated poor in planing and sanding properties, good in shaping and mortising, and fair in turning and boring. Chipped grain and fuzzy surfaces are the most common machining defects. A silica content of only 0.09% is reported.

Durability: Laboratory tests indicate the heartwood to be durable upon exposure to both white-rot and brown-rot fungi. Other evaluations have indicated the wood to be vulnerable to attack by fungi and insects. The wood has been classified as resistant to dry-wood termite attack.

Preservation: Though heartwood penetration is irregular, absorptions of 8 pcf have been obtained using pressure-vacuum treatments in Venezuela. Wood from Panama is considered very difficult to preserve though complete penetration was observed in the sapwood.

Uses: General construction both interior and exterior (heartwood) has been suggested. Furniture, veneer and plywood, boxes and crates, and pulp and paper products have also been recommended.

ADDITIONAL READING

1. Llach C., L.
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ANADENANTHERA MACROCARPA
SYN. PIPTADENIA MACROCARPA

CURUPAY

Family: Leguminosae

Other Common Names: Angico preto (Brazil), Cebil, Cebil colorado (Argentina), Curupay-atá (Paraguay).

Distribution: Has a wide distribution in Argentina but also found in the subtropical and dry forests of Brazil and Paraguay.

THE TREE

A medium-sized tree reaching a height of 80 ft with trunk diameters 2 to 3 ft; boles are straight and clear and will yield logs up to 24 ft in length.

THE WOOD

General Characteristics: Heartwood pale brown, darkening on exposure to reddish-brown with darker colored almost black streaks; sapwood yellow-brown or light pink. Texture fine and uniform; grain usually irregular and interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.86; air-dry density 66 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	22,200	2,370	10,100
15%	26,900	--	12,600
12% (3)	29,290	2,595	14,100

Janka side hardness 3,840 lb. Amsler toughness 680 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries slowly with little warp but does tend to check and split in kiln drying, particularly in thicker dimensions. Kiln schedule T8-B3 is suggested for 4/4 stock and T5-B1 for 8/4. Shrinkage green to ovendry: radial 4.6%; tangential 7.6%; volumetric 12.0%. Movement in service is rated as medium.

Working Properties: The timber is difficult to work on account of its hardness, severe blunting effect on cutting edges. In planing, a cutting angle of 10 to 15 degrees is suggested to prevent tearing of irregular grain.

Durability: Heartwood is rated as very durable.

Preservation: Extremely resistant to preservative treatments.

Uses: Used for heavy exterior construction and marine work, flooring, railroad crossties, tool handles, turnery. The bark is extracted for its tannin.

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1972. Handbook of hardwoods. H. M. Stationery Office. London.
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ANDIRA INERMIS

ANGELIN
PARTRIDGE WOOD

Family: Leguminosae

Other Common Names: Moca (Puerto Rico, Cuba), Cuilimbuco, Maquilla (Mexico), Barbosquillo, Arenillo (Panama), Rode kabbes (Surinam), Acapúrana (Brazil).

Distribution: Occurs throughout the West Indies and from southern Mexico through Central America to northern South America and Brazil. In most locations the tree will grow under varying rainfall and soil conditions.

THE TREE The trees are evergreen, unbuttressed, and of moderate size. Diameters of 20 to 28 in., heights of 90 to 120 ft, and clear boles 60 to 70 ft long are not uncommon.

THE WOOD General Characteristics: The narrow sapwood is pale brown to grayish yellow and usually clearly demarcated from the yellowish brown to dark reddish brown heartwood. Bands of light colored parenchyma tissue give this wood a distinctive figure. Luster rather low; without distinctive odor or taste when dry; texture very coarse; grain only moderately irregular.

Weight: Basic specific gravity (ovendry weight/green volume) 0.64, air-dry density 45 to 60 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	20,870	2,640	--
12% (1)	17,680	2,442	9,130

Janka side hardness about 1,600 lb air dry.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons at a moderate rate with little degrade. Sapwood, during early stages of drying, is susceptible to discoloration by sap-stain fungi. Movement of seasoned wood is rather low. Shrinkage green to ovendry: radial 4.6%; tangential 9.8%; volumetric 12.5%.

Working Properties: Angelim saws and works fairly well except that it is difficult to plane to a smooth surface because of the alternating bands of hard and soft (parenchyma) tissue. The wood works well in the lathe, holds nails and screws well, and glues satisfactorily. Polishes and varnishes well after filling.

Durability: Heartwood is resistant to attack by decay fungi and insects, but is only moderately resistant to dry-wood termites. Sapwood is highly vulnerable to powder-post beetle attack.

Preservation: Heartwood difficult to treat by both hot and cold bath and pressure-vacuum systems. Absorptions are considerably less than 6 pcf with poor penetration. Permeability of sapwood is also low.

Uses: The wood is used locally for heavy construction, cross-ties, house framing, and exterior siding. Other suggested uses are turnery, furniture and cabinet work, parquet flooring, and decorative veneer.

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Llach C., L.
1971. Properties and uses of 113 timber yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
3. Longwood, F. L.
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4. Vink, A. T.
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ANIBA SPP.

LOURO

Family: Lauraceae

Other Common Names: Many species of the Lauraceae may be grouped here, but most are poorly defined botanically. Comino real (Colombia), Silverballi (Guayana), Moena amarilla (Peru), Coto (Bolivia), Louro rosa, Pau rosa (Brazil).

Distribution: Found throughout the Guianas and the Amazon region but also in the Pacific coastal areas of Colombia.

THE TREE Often attains a height of 100 ft with diameters up to 30 in. Clear bole lengths of 55 to 75 ft are obtained.

THE WOOD **General Characteristics:** The woods are typically yellowish with a greenish hue when fresh, becoming brown or olive on exposure. Narrow sapwood light yellowish. Luster medium to high; grain straight to interlocked; texture fine to medium; spicy odor, taste may or may not be distinctive.

Weight: Woods range from rather light to moderately heavy. Basic specific gravity (ovendry weight/green volume) often between 0.55 and 0.65. Air-dry density 40 to 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	13,250	2,170	6,560
12%	19,030	2,570	10,010

Janka side hardness 1,160 lb green and 1,470 lb dry. Forest Products Laboratory toughness 176 in.-lb, average for green and air-dry material (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Moderately difficult to air season, dries at a moderate rate, warp and checking are slight. No kiln schedules available. Shrinkage green to oven-dry: radial 4.7%; tangential 7.0%; volumetric 12.1%.

Working Properties: Easy to work with hand and machine tools and dresses to a smooth surface to give a satiny sheen.

Durability: The timber has an excellent reputation for resistance to decay. Laboratory tests also indicate heartwood very durable to both white-rot and brown-rot fungi.

Preservation: No information available but heartwood is known for its high resistance to moisture absorption and is comparable to teak in this respect.

Uses: Esteemed for high grade furniture, turnery, inlay work. Also favored for boat building, durable construction, and millwork. The wood of Aniba rosaeodora is distilled for its fragrant oil used in the perfume industry.

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APEIBA spp.

DURU

Family: Tiliaceae

Other Common Names: Peine de mico (Mexico), Burillo (Nicaragua), Corcho (Colombia), Cortezo (Panama), Alastioelan, Borredaballi (Surinam), Maqui-sapa (Peru), Cortica, Gargauba (Brazil).

Distribution: The genus has a wide range in tropical America with the center of distribution in northern South America; found in the West Indies, southern Mexico, Central America, and southward to Brazil and Peru.

THE TREE A small to medium-sized tree (A. tibourbou) to large canopy emergent to 120 ft (A. aspera).

THE WOOD General Characteristics: Without distinction between sapwood and heartwood, pale brown to oatmeal color; texture medium to coarse; grain straight; not highly lustrous; without distinctive odor or taste. Wood has bands of soft cottony material that may be sporadic in occurrence.

Weight: Basic specific gravity (ovendry weight/green volume) is very variable due to the irregular bands of soft tissue 0.12 to 0.27; air-dry density 9 to 21 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	4,000	670	--
12% (1)	5,950	380	3,040

Janka side hardness about 250 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is reported to be very easy to season with no drying defects. No kiln schedules available. Shrinkage green to oven dry: radial 2.1%; tangential 6.3%; volumetric 7.8%.

Working Properties: The wood is easy to work in all operations but due to the bands of soft tissue, dressed surfaces are rough. Silica content is reported to be 0.03%.

Durability: The wood is vulnerable to attack by decay fungi.

Preservation: Reported to be easy to impregnate.

Uses: The wood is used to make rafts along the eastern coast of Brazil. Suggested as an insulating material in Colombia.

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ARAUCARIA ANGUSTIFOLIA

PARANA-PINE

Family: Araucariaceae

Other Common Names: Pinheiro do Paraná, Pinho brasileiro (Brazil), Pinheiro do Brasil, Pino blanco (Paraguay), Curiy, Pino Paraná (Argentina).

Distribution: Botanical distribution covers parts of Paraguay and Argentina and the Brazilian plateau region of Rio Grande do Sul, Santa Catharina, and Paraná. Commercial exploitation has been centered in the State of Paraná.

THE TREE The mature trees are from 80 to 120 ft tall, with long clear boles. Diameters up to 60 in. are reported. Crown is flat with upturned limbs.

THE WOOD General Characteristics: Sapwood is yellowish, the heartwood of various shades of brown, often with bright red streaks. Mostly straight grained and of uniform texture without prominent alternating bands of early and late wood. The wood has no distinctive odor.

Weight: Basic specific gravity (ovendry weight/green volume) averages about 0.45. Air-dry density commonly 30 to 40 pcf, averaging 34.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	7,540	1,260	4,180
12%	14,210	1,510	7,980
Green (1)	8,650	1,550	3,810
15%	12,400	--	5,990

Janka side hardness reported to be 560 lb green and 780 lb at 12% moisture content. Amsler toughness 130 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Paraná pine is reported to be more difficult to season than most softwoods, darker-colored material is prone to distortion and splitting and dries more slowly. Piles should be weighted to minimize warp. Kiln schedule T3-D2 is suggested for 4/4 stock and T3-D1 for 8/4 stock. Movement of seasoned wood is rated as medium. Shrinkage green to ovendry: radial 3.8%; tangential 7.3%; volumetric 11.6%.

Working Properties: The wood can be worked easily by hand and machine tools and dresses to a smooth finish. If compression wood is present, there can be considerable distortion when boards are planed, ripped, or resawed. Glues satisfactorily and holds paint well.

Durability: Heartwood is classified as nondurable.

Preservation: Heartwood is moderately resistant, the sapwood is permeable. Reported to absorb water-repellent preservatives readily during 3-minute dipping treatments for millwork. There were practically no differences in the amounts absorbed by light-colored sapwood or dark-colored heartwood.

Uses: Principal uses include framing lumber, interior trim, sash and door stock, furniture, case goods, and veneer. In Brazil the timber is made into plywood and is also considered suitable for pulp and paper products.

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ASPIDOSPERMA spp. (ARARACANGA GROUP)

ARARACANGA

Family: Apocynaceae

Other Common Names: Volador, Pelmax (Mexico), Mylady (Belize), Alcarreto (Panama), Copachi (Colombia), Kromanti kopi (Surinam), Jacamim, Piquiá marfim (Brazil).

Distribution: The species placed in this group are found in Mexico, through Central America and into the high forests on moist terra firma in the lower Amazon region, including the Guianas.

THE TREE Large canopy tree; unbuttressed; up to 120 ft high, with diameters 24 to 36 in.; straight boles often clear to two-third of total tree height.

THE WOOD General Characteristics: Heartwood bright orange-red to reddish-brown when freshly cut becoming light pinkish-brown or pale yellowish-brown upon exposure and drying. Sapwood narrow, white to yellowish, becoming darker on exposure and then not clearly differentiated from the heartwood. Grain straight to irregular; texture medium, uniform; without pronounced odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.70 to 0.80; air-dry density about 53 to 64 pcf.

Mechanical Properties: (First set of values based on the 2-in. standard, the second on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
			Psi
Green (4)*	14,100	2,500	6,650
12%	20,790	2,760	11,110
12% (2)	29,170	3,894	14,480

Janka side hardness for material from Belize was 1,820 lb air-dry, wood from Venezuela tested 3,080 lb. Forest Products Laboratory toughness for Belize timber was 153 in.-lb average for green and air-dry material and 284 in.-lb for the Venezuelan wood (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Not difficult to air season but should be dried at a moderate rate to avoid both end and surface checking. In Surinam 4/4 stock was kiln dried without any difficulties using schedule similar to T7-B3. Shrinkage green to ovendry for Belize material: radial 5.2%; tangential 8.7%; volumetric 14.3%. Volumetric shrinkage about 19% for wood from Guyana and Venezuela.

Working Properties: The wood is reported to machine well and rates fair to excellent in all operations; finishes smoothly and takes a high polish.

Durability: Heartwood is rated very durable in its resistance to both white-rot and brown-rot fungi (Belize source). However, field trials in Venezuela indicate only moderate durability.

Preservation: Heartwood is reported to absorb over 6 pcf of preservative oils using either a hot and cold bath treatment or a pressure-vacuum system; penetration was deep and uniform (test specimens were 20 in. long and not end coated).

Uses: Interior work, paneling, furniture, flooring, turnery, heavy construction, railway crossties, and boat framing.

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1. Echenique-Manrique, R.
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ASPIDOSPERMA spp. (PEROBA GROUP)

PEROBA ROSA

Family: Apocynaceae

Other Common Names: Amarello, Amargoso (Brazil), Ibira-romí, Palo rosa (Argentina).

Distribution: Southeastern Brazil and la Selva Misionera of Argentina. Reported to occur in abundance in the state of São Paulo.

THE TREE A large tree reaching a maximum height of 125 ft with a well formed trunk up to 4 or 5 ft in diameter; clear boles to 30 ft are common.

THE WOOD General Characteristics: Heartwood rose-red to yellowish, often variegated or streaked with purple or brown, becoming brownish yellow to dark brown upon exposure; not sharply demarcated from the yellowish sapwood. Texture fine and uniform; grain straight to irregular; luster low to medium. Odor not distinctive, taste bitter.

Weight: Basic specific gravity (ovendry weight/green volume) averages about 0.65. The wood is moderately heavy weighing 47 pcf air dry.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,460	1,204	5,770
12%	12,760	1,436	8,250
Green (1)	12,760	1,338	6,020
15%	15,024	--	7,880

Janka side hardness reported to be 1,580 lb for green wood and 1,732 lb at a moisture content of 12%. Amsler toughness is 206 in.-lb at a moisture content of 15% (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood dries with little checking or splitting, but some warp may develop. Kiln schedule T6-D2 is suggested for 4/4 stock and schedule T3-D1 for 8/4 stock. Shrinkage green to ovendry: radial 3.8%; tangential 6.4%; volumetric 11.6%.

Working Properties: The wood works with moderate ease, although some difficulties may be anticipated with irregular grain. It takes finishes readily and can be glued satisfactorily.

Durability: Heartwood is rated durable but is susceptible to dry-wood termite attack.

Preservation: Heartwood is reported to be extremely resistant to preservation treatments.

Uses: Suitable for general construction work, favored for fine furniture and cabinet work and decorative veneers. Other uses include flooring, interior trim, sash and doors, and turnery.

ADDITIONAL READING

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ASTRONIUM GRAVEOLENS

GONCALO ALVES

Family: Anacardiaceae

Other Common Names: Palo de cera, Palo de culebra (Mexico), Gusanero (Colombia), Gateado (Venezuela), Guaritá (Brazil), Guasango (Ecuador).

Distribution: Gonçalo Alves is a common tree in the upland forests of many regions from Mexico and Central America through to Colombia, Venezuela, Brazil, and Ecuador.

THE TREE Attains diameters of 24 to 40 in. or more and a maximum height of 120 ft. Except for narrow buttress flanges 4 to 6 ft tall, it has a clear cylindrical trunk for two-thirds or more of its height. The logs are typically sound throughout.

THE WOOD General Characteristics: When fresh, the heartwood is russet-brown, orange-brown, or reddish-brown to red with narrow to wide irregular stripes of medium to very dark brown. After exposure it becomes brown, red, or dark reddish-brown with nearly black stripes. The dingy grayish or brownish-white sapwood, 2 to 4 in. wide, is sharply demarcated. Grain variable, straight to roey; texture fine to medium, uniform; no distinctive odor or taste. The wood often has a striking figure caused by irregular dark longitudinal bands.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.84 for timber from Honduras and Venezuela; material from Brazil and Colombia averages 0.75. Average air-dry density is about 60pcf from these four sources.

Mechanical Properties: (First set of values based on 2-in. standard; second set based on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	12,140	1,940	6,580
12%	16,620	2,230	10,320
Green (1)	17,170	2,000	8,930
15%	19,670	--	11,100

Janka side hardness 1,910 lb for green material and 2,160 lb for dry. Forest Products Laboratory toughness average for green and dry material from Honduras and Venezuela is 139 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Moderately difficult to season. Some crook and bow accompanied by a slight tendency to twist, checking slight. Air dries at a fast to moderate rate. A kiln schedule similar to T3-C2 has been suggested. Shrinkage green to ovendry: radial 4.0%; tangential 7.6%; volumetric 10.0%; slightly higher for Brazilian material.

Working Properties: It is not difficult to work in spite of its high density, finishes very smoothly, and takes a high polish. The wood weathers well and is highly resistant to moisture absorption. It is reported to be difficult to glue.

Durability: Laboratory tests indicate the heartwood to be very durable in resistance to both white-rot and brown-rot organisms. These results substantiate the reputed high durability of this species.

Preservation: Using either hot and cold bath or pressure-vacuum systems, sapwood absorbs only 2 to 4pcf of preserving oils; heartwood absorbed one-half of this amount.

Uses: Among the most outstanding heavy, durable construction timbers, also highly favored as a fine furniture and cabinet wood. Cut for decorative veneers. It is used for specialty items such as knife handles, brush backs, archery bows, billiard cue butts, turnery, and carving.

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BAGASSA GUIANENSIS

BAGASSE

Family: Moraceae

Other Common Names: Cow-wood (Guyana), Gele bagasse (Surinam), Bagasse jaune (French Guiana), Tatajuba, Amapá-rana (Brazil).

Distribution: Rather infrequent occurrence in the Guianas and the Brazilian Amazon.

THE TREE A large, well-formed, unbuttressed canopy tree with a flat, umbrella-shaped crown. The trees are generally 20 to 24 in. in diameter, and 90 to 100 ft in height. The bole is cylindrical and 60 to 70 ft high. Bark, when cut, yields large quantities of a sweet, sticky latex.

THE WOOD General Characteristics: Unseasoned heartwood is yellow, often streaked with brown, becoming lustrous golden-brown to russet on exposure. Sapwood is narrow, sharply demarcated, pale yellow to yellowish-white. Grain usually interlocked resulting in a rather broad stripe; texture medium to coarse, moderately uniform; odor and taste not distinctive when seasoned.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.68. Air-dry density averages 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	14,510	2,300	7,900
12%	20,050	2,580	11,560

Janka side hardness 1,670 lb for green wood and 1,730 lb for dry. Forest Products Laboratory toughness average for green and dry material is 196 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood air seasons at a moderate rate with very little tendency to warp or check. No kiln schedules are available. Shrinkage green to ovendry: radial 5.2%; tangential 6.6%; volumetric 10.2%. Volumetric shrinkage is exceptionally low for a wood of this density.

Working Properties: Easy to saw and finishes smoothly.

Durability: Heartwood is reported to be very durable when exposed to either white-rot or brown-rot fungi; slightly resistant to marine borers. Weathering characteristics are considered poor.

Preservation: Heartwood is highly resistant to moisture absorption, comparable to teak in this respect, suggesting poor treatability.

Uses: Wood used locally for general building purposes, heavy construction, furniture, boat construction. Because of its high resilience, it may be suitable for some types of sporting equipment. Wood is similar to black locust and could be used as a substitute for some applications.

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BALFOURODENDRON RIEDELIANUM

PAU MARFIM

Family: Rutaceae

Other Common Names: Marfim, Pau liso (Brazil), Guatambú, Guatambú blanco (Argentina).

Distribution: State of São Paulo, Brazil; northern and central Paraguay; and the Selva Misionera, Argentina.

THE TREE A small to medium-sized tree rarely up to 80 ft high and 30 in. in diameter. Has a well formed, straight bole up to 30 ft high.

THE WOOD General Characteristics: A nearly white or pale yellowish brown wood without apparent contrast between sapwood and heartwood. Luster medium; grain generally straight; texture fine and uniform; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.73 for wood grown in Brazil and 0.65 for Argentinian material. Air-dry density averages about 50pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	15,170	1,665	6,320
15%	19,870	--	8,535

Amsler air-dry toughness 581 in.-lb (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Can be dried without excessive degrade. Kiln schedule T6-C3 is suggested for 4/4 stock, and schedule T5-C2 for 8/4. Shrinkage green to ovendry: radial 4.6%; tangential 8.8%; volumetric 13.4%.

Working Properties: Limited information suggests that the wood can be sawn and worked without undue difficulty. It is nonsiliceous and nonresinous and unlikely to have a marked blunting effect on tools; easy to finish and is reported to glue satisfactorily.

Durability: Heartwood is rated as nondurable.

Preservation: Reported to be resistant to treatment by pressure methods.

Uses: Furniture, cabinetwork, tool handles, flooring turnery. Suggested as a substitute for birch and hard maple.

ADDITIONAL READING

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BERTHOLLETIA EXCELSA

BRAZIL-NUT TREE

Family: Lecythidaceae

Other Common Names: Castaña del Marañón (Colombia), Juvia, Yubia (Venezuela), Brazilnoot (Surinam), Castanha verdadeira, Castanheiro (Brazil).

Distribution: Common throughout the Amazon region of Brazil, Venezuela, Colombia, and Peru. In Venezuela also found in the forests of the upper Orinoco and Rio Negro. Reaches its best development on well-drained clayish or sandy clay soils.

THE TREE One of the largest trees of the Amazon region. Diameters occasionally reach 12 ft, and heights up to 160 ft; excellent form. The tree is highly valued for its seeds, the Brazil nuts of commerce.

THE WOOD General Characteristics: Heartwood is uniform pinkish-brown becoming light chestnut brown after exposure to light. Sapwood is about 2 to 4 in. thick, pale yellowish brown, sharply demarcated from heartwood. Texture rather coarse to medium; luster medium; grain typically interlocked; odor and taste not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.59. Air-dry density 44 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	9,740	1,610	4,530
12%	14,680	1,760	6,890

Janka side hardness 940 lb green and 1,150 lb air dry. Forest Products Laboratory toughness average for green and dry material is 143 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood air dries rapidly with very little degrade. Warp and checking are slight with a minimum of casehardening. No kiln drying data available. Shrinkage green to ovendry: radial 3.9%; tangential 8.3%; volumetric 11.2%. Has a very low rate of moisture absorption.

Working Properties: The wood is moderately difficult to work, glues readily, and finishes smoothly. Exudations of gum tend to clog saws in cutting green material. Moderately easy to cut into smooth tight veneer of uniform thickness.

Durability: Laboratory tests indicate heartwood is very durable to durable in resistance to white-rot and brown-rot fungi. The wood displays good weathering characteristics.

Preservation: Low rates of moisture absorption suggest a poor response to preservation treatments.

Uses: Boat and ship decking, steam-bending applications, railroad ties, exterior construction, tanks, flooring, furniture, and cabinet stock. If free of gum, splits, and tension wood, should be suitable for interior decorative panels.

ADDITIONAL READING

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1949. Timbers of the new world. Yale University Press. New Haven, Conn.
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1952. Properties and uses of tropical woods, III. Tropical Woods 98:1-109.

BOMBACOPSIS QUINATA

POCHOTE

Family: Bombacaceae

Other Common Names: Cedro espino (Honduras, Nicaragua), Saquisaqui (Venezuela), Ceiba toluca (Colombia).

Distribution: Common in the more open forests of western Nicaragua, Costa Rica, and Panama. Also on the Atlantic side of Panama and in Colombia and Venezuela. Abundant throughout its range, mostly on well-drained, often gravelly soils on the upper slopes of low hills and ridges.

THE TREE Medium sized to large tree, not infrequently 3 ft and sometimes 5 or 6 ft in diameter; reaches a height of 100 ft. Wide-spreading crown of heavy branches; somewhat irregular bole; generally buttressed. Trunk and larger branches armed with hard sharp prickles.

THE WOOD General Characteristics: Heartwood is uniform pale pinkish or pinkish-brown when freshly cut, becoming light to dark reddish-brown on exposure; sharply demarcated from yellowish sapwood. Grain straight to slightly interlocked; texture medium; luster rather low. Heartwood without distinctive odor but sometimes with a slightly astringent taste.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.45. Air-dry density about 34 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
			Psi
Green (3)*	7,560	1,260	3,440
12%	10,490	1,400	5,660
12% (2)	12,110	--	6,480

Janka side hardness 650 lb for green material and 720 lb for dry. Forest Products Laboratory toughness average for green and dry material is 103 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air seasons very slowly, required almost a year to dry 8/4 stock to a moisture content of 20%. Warp and checking slight. Shrinkage green to ovendry: radial 3.4%; tangential 6.2%; volumetric 10.0%.

Working Properties: The wood has been reported as easy to work, finishing smoothly; also easy to nail.

Durability: The heartwood is rated as durable in its resistance to white-rot fungi, very durable in resistance to brown rots. Susceptible to attack by both dry wood and subterranean termites. Good resistance to marine borers reported in Panama waters.

Preservation: Heartwood is very difficult to treat with very poor absorption and penetration. Sapwood can absorb 10 to 20pcf of preservative using either hot and cold bath or pressure systems; penetration though is irregular.

Uses: Used locally for general construction, interior finish, millwork, furniture stock, veneer and plywood, particleboard, and pulp and paper products.

ADDITIONAL READING

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2. Villamil G., F. (ed.).
1971. Maderas colombianas. Proexpo, Bogota.
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1952. Properties and uses of tropical woods, III. Tropical Woods 98:1-109.

BOWDICHIA spp.

SUCUPIRA

Family: Leguminosae

Other Common Names: Alcornoque (Venezuela), Sapupira, Sucupira parda (Brazil).

Distribution: B. nitida occurs in the forests of the Rio Negro and lower Amazon region. B. virgiliooides has a greater range from Venezuela and the Guianas to southeastern Brazil.

THE TREE On favorable sites it is a medium sized to large tree, up to 150 ft high and diameter to 4 ft. Over part of its range it is a savanna tree of small size and poor form.

THE WOOD General Characteristics: Heartwood dull chocolate to reddish brown, with parenchyma striping; sharply demarcated from whitish sapwood. Luster low; texture coarse with harsh feel; grain irregular and interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) averages 0.74. Air-dry density about 56 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	18,150	2,270	10,140
15%	20,450	--	11,560

Air-dry Amsler toughness 396 in.-lb (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: No information on drying characteristics. A kiln schedule similar to T5-B2 has been suggested. Shrinkage green to ovendry: radial 5.0%; tangential 7.8%; volumetric 13.4%.

Working Properties: Difficult to work on account of its high density and interlocked and irregular grain, but can be finished fairly smoothly. Glues well.

Durability: Heartwood reported to be very durable; railroad ties in the Netherlands showed no sign of decay after 17 years of service.

Preservation: No information available.

Uses: Suggested for heavy durable construction, railway ties, and other uses not requiring much fabrication.

ADDITIONAL READING

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1972. Handbook of hardwoods. Her Majesty's Stationery Office, London.
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1949. Timbers of the new world. Yale University Press, New Haven, Conn.

BROSIMUM SPP. (ALICASTRUM GROUP)

CAPOMO

OJOCHE

Family: Moraceae

Other Common Names: Masicarón (Guatemala, Honduras), Ojuste (El Salvador), Guaimaro, Manata (Colombia), Tillo (Ecuador), Muiratinga (Brazil).

Distribution: B. alicastrum and other closely related species are found in southern Mexico through Central America and southward into the Peruvian Amazon.

THE TREE Trees reach a height of 120 ft, with straight cylindrical boles clear to 75 ft; diameters may range up to 30 to 40 in.

THE WOOD General Characteristics: Both sapwood and heartwood a uniform yellowish-white; wood around knots and other defects may be a distinct red. Texture is fine to medium; grain is straight to irregular and shallowly interlocked; luster low; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) very variable with species ranging between 0.55 to 0.72. Air-dry density from 45 to 65 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	17,610	1,850	--
12% (4)	16,050	1,850	--
12% (5)	16,610	--	8,870

Janka side hardness ranges between 1,340 lb and 1,700 lb dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Easy to moderately difficult to air dry, tendency to twist. No information on kiln drying. Shrinkage green to ovendry: 5.1% radial; 9.4% tangential; 15.4% volumetric.

Working Properties: Reported to be easy to moderately difficult to machine. Because of its density and a silica content of 0.68%, proper cutters should be selected. Figured wood is sliced for face veneers without difficulty.

Durability: Durability is low, vulnerable to attack by white-rot and brown-rot fungi. Particularly susceptible to insect attack because of abundant starch.

Preservation: No information available.

Uses: General construction work, flooring, furniture, cabinet work, veneers, and tool handles. Cooked seeds of B. alicastrum are edible.

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1971. Maderas colombianas. Proexpo, Bogotá.

BROSIMUM spp. (UTILE GROUP)

COW-TREE, SANDE

Family: Moraceae

Other Common Names: Mastate (Costa Rica), Avichuri (Colombia), Palo de vaca (Venezuela), Amapá doce, Caucho macho (Brazil).

Distribution: Ranges from the Atlantic Coast in Costa Rica southward to Colombia and Ecuador.

THE TREE The tree attains a height of 80 to 100 ft with an erect trunk about 30 to 45 in. in diameter.

THE WOOD General Characteristics: Dried there is no distinction between sapwood and heartwood, uniform yellowish-white to yellowish-brown or light brown. Grain is straight to widely and shallowly interlocked; medium texture; luster high. Odorless and tasteless.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.35 to 0.50 for this group. Air-dry density averages about 24 to 38 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	8,490	1,940	4,490
12%	14,310	2,390	8,220

Janka side hardness 603 lb for green material and 903 lb for air dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: The lumber air seasons rapidly and easily with little or no degrade. However, material containing tension wood will be subject to warp. Kiln schedule T5-C3 has been suggested for 4/4 stock. A faster schedule was developed that can dry this wood to 7 percent moisture content in 6 to 8 days (2). Shrinkage green to ovendry: radial 3.9%; tangential 7.8%.

Working Properties: The wood is easy to machine. However, tension wood is sometimes prevalent and this will cause fuzzy grain and burning of saws due to pinching. Takes stains and finishes readily ;presents no gluing problems.

Durability: The wood is vulnerable to attack by stain and decay fungi as well as insects.

Preservation: Reported to be treatable, but with no detailed information.

Uses: Plywood, particleboard, fiberboard, carpentry, light construction, furniture components, pulp and paper products, and moldings.

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BUCHENAVIA CAPITATA

YELLOW SANDERS

Family: Combretaceae

Other Common Names: Granadillo (Puerto Rico), Almendro (Colombia), Amarillo, Olivo negro (Venezuela), Mirindiba, Periquiteira (Brazil).

Distribution: West Indies, Panama, and South America from Venezuela to French Guiana, Brazil, and Bolivia. Several related species are found in the Amazon region.

THE TREE Growing to a height of 60 to 80 ft and 2 to 4 ft in trunk diameter; rather large buttresses, but has a good log form above this.

THE WOOD General Characteristics: Heartwood yellowish-brown when freshly cut becoming yellow- to golden-brown usually with a gray or olive hue upon exposure; sapwood light yellow-brown. Grain more or less interlocked; texture medium to rather coarse; luster high; with faint spicy odor and mildly bitter taste when green.

Weight: Basic specific gravity (ovendry weight/green volume) 0.63; air-dry density 47pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	10,050	1,460	5,130
12%	12,970	1,650	7,440

Janka side hardness averages 1,220 lb for air-dry wood. FPL toughness average for green and dry material is 123 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Lumber air seasons rapidly with only a very small amount of degrade in the form of slight bow and twist. This species also performed well in a solar dryer (5/4 stock). No kiln schedules are available. Shrinkage green to ovendry: radial 2.8%; tangential 5.7%; volumetric 8.6%. Very low values for a wood of this density.

Working Properties: The wood machines with moderate difficulty because of its hardness, but it produces good surfaces in all operations even though some tearing may result from irregular grain. Performs well in spindle carving. Easy to finish. Rated as fair in steam-bending characteristics.

Durability: Heartwood reported as fairly resistant to decay and to attack by termites and rated as very resistant to attack by dry-wood termites. The wood has little resistance to marine borers. The wood weathers well. Heartwood is relatively high in resistance to moisture absorption. Sapwood highly vulnerable to powder-post beetle attack.

Preservation: Sapwood treatability with oil- or water-based preservatives is rated very low; absorptions can be greatly improved by incising. Heartwood impermeable.

Uses: An attractive furniture wood and suggested for decking, planking, and framing in boat construction; exterior and interior flooring; decorative veneers; turning; wood tanks. The wood has many characteristics similar to white oak and teak.

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BUCIDA BUCERAS

JUCARO

OXHORN BUCIDA

Family: Combretaceae

Other Common Names: Black-olive (Jamaica), Ucar, Gregre (Puerto Rico), Bois gri-gri (Haiti), Grignon (French Guiana), Leertouwarsboom (Surinam).

Distribution: Upper Florida Keys, Bahamas, Cuba, Jamaica, Hispaniola, Puerto Rico and Virgin Islands, and Leeward Islands to Guadeloupe in Lesser Antilles. Also from southern Mexico to Panama and northern South America along the coasts of Colombia, Venezuela, and the Guianas.

THE TREE A widely spreading timber and shade tree, medium to large sized, 30 to 60 ft high and to 3 ft in trunk diameter, sometimes to heights of 110 ft and diameters of 5 ft, with erect cylindrical boles.

THE WOOD General Characteristics: Heartwood yellowish- to greenish-brown, olive hued; not always sharply demarcated from yellowish- to light-brown sapwood. Longitudinal stripes are frequent as a result of roey grain; moderately fine to medium in texture; very lustrous. Although green wood has a tarry odor, seasoned wood has no characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.93; air-dry density 69 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	15,400	2,000	--

Janka side hardness 2,340 lb for green wood.

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood is moderately easy to season for a timber of high density; only minor amounts of warping and checking occur. Shrinkage green to ovendry is also low for its weight: radial 4.4%; tangential 7.9%; volumetric 12.2%. No kiln schedules available.

Working Properties: The wood is rather difficult to saw and machine with hand and power tools because of its very high density. Very smooth finishes can be obtained, however torn grain is common in planing.

Durability: Resistant to dry-wood termites and durable in ground contact but not resistant to marine borers.

Preservation: Both sapwood and heartwood are resistant to impregnation with preservatives.

Uses: Highly valued for posts, poles, railway crossties, and other durable construction; heavy duty flooring, workbenches; charcoal. The bark has been employed in tanning.

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BULNESIA ARBOREA

VERAWOOD

MARACAIBO LIGNUM-VITAE

Family: Zygophyllaceae

Other Common Names: Guayacán, Guayacán de bola (Colombia),
Bera, Cuchivaro, Vera aceituna (Venezuela).

Distribution: Coastal region of Colombia and Venezuela,
common on the dry foothills between Porto Cabello and
Lake Maracaibo.

THE TREE Occasionally 100 ft tall but usually 40 to 50 ft with a
trunk diameter of 14 to 20 in.; boles slender,
straight, and of rather good form, free of branches
for 15 to 20 ft.

THE WOOD General Characteristics: Heartwood more or less striped
and banded, varying in color from light olive-green to
chocolate-brown; surface of fresh wood often turns
dark green upon exposure. Sapwood is mostly thin and
light yellow in color. Fine textured; cross-grained;
oily appearance and feel; mildly and pleasantly scented
when warmed.

Weight: Basic specific gravity (ovendry weight/green volume)
1.00; air-dry density 78pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: Owing to its high density and the resinous nature of the timber, the wood dries slowly and needs careful handling to avoid splitting; also prone to ring shake. No shrinkage data available.

Working Properties: When seasoned, it is not easy to work either with machine or hand tools but does turn well in the lathe.

Durability: Heartwood is very durable under exposure and will last indefinitely in the ground.

Preservation: Not treatable.

Uses: Because of its high density and self-lubrication, has many uses similar to that of Guaiacum but is not considered as suitable for propeller-shaft bushings. Used as steps and collars for water turbines, mallet heads, pulley wheels, brush backs, locally for railway crossties.

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BURSERA SIMARUBA

GUMBO-LIMBO
ALMÁCIGO

Family: Burseraceae

Other Common Names: Turpentine tree (Jamaica), Commier blanc (Haiti), Chaca, Palo chino (Mexico), Carate (Panama, Colombia), Caraña, Indio desnudo (Venezuela).

Distribution: Of common occurrence in southern Florida, the West Indies, southern Mexico, Central America, and northern South America. The tree is not exacting as to site and moisture conditions but reaches its best development in lowland forests. On some sites it occurs as pure or nearly pure forests.

THE TREE Generally a slender unbuttressed tree of short to medium height, commonly to 60 ft; diameters 14 to 18 in. Sometimes attain heights of 80 to 90 ft with trunk diameters of 3 ft.

THE WOOD General Characteristics: Heartwood is white, yellowish, or light brown, not differentiated from sapwood. Texture is fine to medium; grain fairly straight to irregular; moderate to rather high luster; without distinctive taste or odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.30 to 0.38; air-dry density reported to range from 19 to 30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	3,300	560	1,510
12%	4,800	740	3,080
12% (3)	5,560	1,080	--

Janka side hardness reported to be 270 lb air dry and 230 lb for green wood.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons rapidly with minor degrade in the form of very slight checking and warp. Logs and lumber are very susceptible to attack by sap-stain fungi, requiring rapid conversion and chemical control. Shrinkage green to ovendry: radial 2.6%; tangential 4.2%; volumetric 7.3%.

Working Properties: The wood works easily with either hand or machine tools but with some fuzziness and torn grain. The use of very sharp, thin cutting edges and reduced feed rates are suggested. The wood has excellent resistance to screw splitting and holds nails firmly. Logs are reported to peel well on rotary lathes without preheating.

Durability: The wood is not durable in ground contact and is vulnerable to powder-post beetle and termite attack.

Preservation: Capable of good absorption using either oil- or waterborne preservatives.

Uses: The timber is used for matchsticks, boxes, crates, house construction, and general carpentry; also suggested for pattern and core stock. Manufactured into a utility plywood in Mexico. Tree is used extensively as "live fencing;" also yields an aromatic resin used as an incense and varnish.

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BYRSONIMA CORIACEA VAR. SPICATA
and BYRSONIMA SPP.

SERRETTE

Family: Malpighiaceae

Other Common Names: Golden spoon (British West Indies), Maricao (Puerto Rico), Changugo (Mexico), Chaparro (Colombia), Candelo (Venezuelo), Kanoaballi (Guyana), Chupi-cara (Peru), Murici (Brazil).

Distribution: Throughout West Indies, Central America, Colombia, the Guianas, Peru, Bolivia, and Brazil. Common in secondary forests and frequently on lands degraded by farming.

THE TREE Generally may reach a height of 100 to 120 ft, with trunk diameters up to 3 ft. Straight cylindrical bole free of buttresses, and clear to 60 to 70 ft.

THE WOOD General Characteristics: Heartwood pale to dark reddish-brown with a purplish cast, sometimes with a grayish tint. Gray to reddish-brown sapwood somewhat distinct from heartwood. Grain mostly straight or slightly interlocked; texture moderately fine; medium luster; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.61; air-dry density 46pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	12,200	1,570	5,800
12%	18,000	1,950	9,750

Janka side hardness 1,140 lb when green and 1,530 lb for air-dry wood. Forest Products Laboratory toughness reported to be 132 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood air seasons fairly well, drying at a rather slow to moderate rate; end and surface checking are slight but some tendency to warp. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.0%; tangential 8.2%; volumetric 12.2%.

Working Properties: The wood works fairly easily with both hand and power tools; good to excellent surfaces are produced in all operations. Proper size lead holes must be prebored before screws are driven or the wood splits rather badly.

Durability: The wood is very susceptible to dry-wood termites and other wood-destroying insects, only slightly resistant to decay fungi; no appreciable resistance to marine borers.

Preservation: Heartwood and sapwood are both moderately resistant to impregnation; good end penetration, however, suggests favorable response to incising.

Uses: General carpentry, furniture and cabinet work, flooring, and turnery. It has been suggested for plywood and veneer.

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CABRALEA CANGERANA

CANGERANA

Family: Meliaceae

Other Common Names: Cajarana, Pau de santo (Brazil),
Cancharana Canxarana (Argentina), Congerana (Uruguay),
Cedro-rá (Paraguay).

Distribution: Found in Paraguay, Uruguay, and Argentina but
is most abundant in central and southeastern Brazil.

THE TREE Usually of medium height but with a large trunk up to 4 ft
in diameter.

THE WOOD General Characteristics: Heartwood typically dull red or
maroon, sometimes lighter colored with purplish streaks;
not always sharply demarcated from the pinkish sapwood.
The wood has a fragrant scent when fresh but without
odor or taste when dry. Texture medium to coarse;
grain generally straight, sometimes wavy.

Weight: Basic specific gravity (ovendry weight/green
volume) 0.55; air-dry density 42 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	10,100	1,360	5,700
15%	12,700	--	7,400

Air-dry Amsler toughness 147 in.-lb (2-cm
specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: No data available on drying characteristics. Shrinkage green to ovendry: radial 3.4%; tangential 6.6%; volumetric 10.4%.

Working Properties: The wood is easy to work, finishes smoothly.

Durability: Heartwood highly resistant to attack by decay fungi and insects.

Preservation: No data available.

Uses: General carpentry, interior and exterior construction, joinery, fine furniture, favored in Brazil for carving.

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CAESALPINIA spp.
SYN. LIBIDIBIA spp.

PART RIDGEWOOD
COFFEEWOOD

Family: Leguminosae

Other Common Names: Ebano (Mexico), Granadillo (Colombia, Venezuela).

Distribution: Chiefly Venezuela but also found in Colombia, Ecuador, and Peru.

THE TREE Mature trees are from 50 to 75 ft tall, with a well-formed trunk sometimes 36 in. in diameter, clear of branches for 35 ft.

THE WOOD General Characteristics: Heartwood dark red to chocolate-brown or nearly black, usually with fine pencil-striping of parenchyma; sharply demarcated from the yellowish- or pinkish-white sapwood. Luster medium to low; texture medium to coarse; grain straight to very irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 1.05; air-dry density 78 pcf.

Mechanical Properties: A heavy strong timber, but no technical data available on mechanical properties.

Drying and Shrinkage: Requires care in seasoning, slow drying. With adequate precautions, results are satisfactory. No shrinkage data available. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4.

Working Properties: Difficult to work, but finishes smoothly; works very well in turnery.

Durability: Highly resistant to attack by decay fungi.

Preservation: Not treatable.

Uses: Specialty turnery. In countries of origin used for heavy construction work.

ADDITIONAL READING

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CALOPHYLLUM BRASILIENSE

SANTA MARIA
JACAREUBA

Family: Guttiferae

Other Common Names: Barí, Leche de María (Mexico), Calaba (Panama), Aceite maria (Colombia), Edaballi, Kurahara (Guayana), Balsamaria (Bolivia), Guanandi, Jacareuba (Brazil).

Distribution: Grows throughout the West Indies and from Mexico southward through Central America and into northern South America. It is found on all types of soils as well as wet humid to very dry sites.

THE TREE When conditions are favorable, the tree attains a height of 100 to 150 ft with a long straight clear bole 3 to 6 ft in diameter; unbuttressed.

THE WOOD General Characteristics: Heartwood varies in color from pink or yellowish-pink to brick red or rich reddish-brown; sapwood 1 to 2 in. wide, lighter in color and not always clearly differentiated from heartwood. Texture medium and fairly uniform; grain generally interlocked; luster rather low to medium; odor and taste not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) 0.51; air-dry density 39pcf.

Mechanical Properties: (First set of values based on 2-in. standard, second set of values based on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,490	1,590	4,560
12%	14,640	1,830	6,910
Green (1)	11,100	1,470	5,490
12%	15,700	1,710	8,730

Janka side hardness 890 lb for green wood and 1,150 lb for dry. Forest Products Laboratory toughness average for green and dry material is 180 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is moderately difficult to air season, drying rate varies considerably, warp is moderate to severe, surface checking is slight. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage from green to oven-dry: radial 4.6%; tangential 8.0%; volumetric 13.6%. Movement in service is rated as medium.

Working Properties: The wood is fairly easy to work and generally yields smooth surfaces on straight-grained material but generates torn and chipped grain when interlocked; rates below average in planing, turning, and boring. Rotary cutting of this species for veneer has not been satisfactory.

Durability: The heartwood is generally rated as durable to moderately durable with respect to decay resistance; rated as very susceptible to attack by dry-wood termites; not resistant to marine borers.

Preservation: Heartwood is very resistant to impregnation by non-pressure and pressure systems. Sapwood has good permeability if incised.

Uses: Widely used in the tropics for general construction, flooring, furniture, boat construction; a favored general utility timber.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods (2d ed.). H. M. Stationery Office. London.
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1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
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CALYCOPHYLLUM CANDIDISSIMUM

**DEGAME
LEMONWOOD**

Family: Rubiaceae

Other Common Names: Camarón, Palo camarón (Mexico), Surrá (Costa Rica), Alazano (Panama), Guayabo (Colombia), Araguato, Betún (Venezuela).

Distribution: Occurs in Cuba and ranges from southern Mexico through Central America to Colombia and Venezuela. Degame may occur in pure stands and is common on shaded hillsides and along waterways.

THE TREE A small to medium-sized tree usually 40 to 50 ft high but may reach heights of 90 ft and diameters to 30 in. Boles usually straight and free of branches for half the total tree height.

THE WOOD General Characteristics: Heartwood ranges from light brown to oatmeal color and is sometimes grayish. Sapwood is lighter in color and merges gradually with the heartwood. Luster is low to medium; texture fine and uniform; grain is straight to interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.67; air-dry density 51pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	14,290	1,930	6,200
12%	22,300	2,270	9,670

Janka side hardness 1,630 lb when green and 1,940 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 252 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Some tendency to warp when dried as small squares (for archery bows); also some surface and end checking occurs in plank stock. Kiln schedule T2-C2 is suggested for 4/4 lumber and T2-C1 for 8/4. Shrinkage green to ovendry: radial 4.8%; tangential 8.6%; volumetric 13.2%.

Working Properties: The wood is difficult to saw and moderately difficult to work in planing and boring; no appreciable dulling effect on cutters. Machined surfaces are very smooth; takes a glossy polish.

Durability: The wood is generally regarded as lacking appreciable resistance to attack by decay fungi. Pure-culture laboratory tests indicate high durability when exposed to a brown-rot fungus but only moderately durable with respect to deterioration by a white-rot fungus. Reported to be highly resistant to marine borers.

Preservation: No information available.

Uses: Has been used in the manufacture of archery bows and fishing rods. Suitable for tool handles and turnery and is used for shuttles and picker sticks and other textile manufacturing items.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods (2d ed.). H. M. Stationery Office. London.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.
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1955. Properties and uses of tropical woods, V. Tropical Woods No. 103:1-139.

CAMPNOSPERMA PANAMENSIS

SAJO
OREY

Family: Anacardiaceae

Other Common Names: Not known.

Distribution: Reported in the Atlantic lowlands of northern Panama, adjacent Costa Rica, and Pacific coastal regions of Colombia; forms almost pure stands in these marshy areas.

THE TREE Medium-sized trees 40 to 60 ft high with bole diameters of 10 to 15 in., occasionally up to 24 in.; well formed stems that are often clear to 30 ft.

THE WOOD General Characteristics: Heartwood white to grayish-buff sometimes with a yellowish tint; no marked contrast with the sapwood. Somewhat silvery luster; fine textured; straight grained; distinctive odor when fresh, but without characteristic odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume) 0.33; air-dry density 25 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	5,080	1,070	2,660
12%	8,700	1,480	5,200

Janka side hardness 336 lb for green material and 425 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: The lumber air seasons rapidly with little or no tendency to warp or check. Kiln schedule T5-C3 has been suggested for 4/4 stock. A faster schedule has been suggested that can dry this wood to 7% moisture content in 6 to 8 days (2). No shrinkage data available.

Working Properties: This is a wood that is easy to saw and machine with ordinary shop tools; holds nails well; finishes smoothly.

Durability: The wood is not resistant to attack by decay fungi or insects; prone to blue stain.

Preservation: The wood is reported to be easy to treat.

Uses: Boxes and food containers, furniture components, millwork, moldings, plywood, particleboard, fiberboard, pulp and paper products; also suggested for pencil slats.

ADDITIONAL READING

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2. McMillen, J. M., and R. S. Boone.
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3. Mothershead, J. S., and J. H. Markley.
1973. Tropical wood evaluation and utilization experiences. Forest Prod. J. 23(4):32-37.
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1971. Maderas colombianas. Proexpo, Bogotá.

CARAPA GUIANENSIS

CRABWOOD
ANDIROBA

Family: Meliaceae

Other Common Names: Cedro macho (Costa Rica), Bateo (Panama), Mazabalo (Colombia), Carapa (Venezuela), Krapa (Surinam), Figueroa, Tangaré (Ecuador), Andiroba (Peru, Brazil).

Distribution: Occurs in the West Indies from Cuba to Trinidad and from Honduras south through Central America, the Guianas, and into Brazil, Colombia, and Peru, and the overflow delta lands of the Orinoco in Venezuela; often occurs in pure stands; a lowland species but also at high altitudes along rivers.

THE TREE Commonly 80 to 100 ft in height with diameters 2 to 3 ft; sometimes attain diameters up to 6 ft and heights of 170 ft. Buttresses are low, leaving a clear bole length of 50 ft or more; main stems are straight and of good form.

THE WOOD General Characteristics: Heartwood is a light salmon to reddish-brown when fresh becoming darker when dry, color very variable; sapwood is pinkish turning pale brown or grayish not always sharply demarcated from heartwood. Texture varies from fine to coarse; luster ranges from low to high; grain usually straight but sometimes roey; odor and taste lacking.

Weight: Basic specific gravity (ovendry weight/green volume) 0.56; air-dry density 41 pcf.

Mechanical Properties: (First set of values based on 2-in. standard; second set, 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	11,110	1,560	4,930
12%	15,620	1,850	7,900
12% (1)	15,500	2,080	8,540

Janka side hardness 1,060 lb for green material and 1,220 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 130 in.-lb (5/8-in specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Experience is variable, reported to air season and kiln dry rather slowly with a tendency to split, check, and collapse but without serious bowing or cupping; also reported to be only moderately difficult to air dry with only slight checking and warp. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 3.1%; tangential 7.6%; volumetric 10.4%. Movement in service is rated small.

Working Properties: Can be worked with machine and hand tools; reported to be somewhat harder to machine than mahogany; has a tendency to split when nailed; glues and screws well; peels well for veneer.

Durability: Very variable, laboratory tests report both high and low resistance to brown- and white-rot fungi; also variously reported to be resistant or poorly resistant to decay in the ground. Reported to be very susceptible to dry-wood termite attack; also vulnerable to powder-post beetle attack. Comparable to mahogany in weathering properties.

Preservation: Absorption is low and penetration is poor in heartwood treated by either pressure or nonpressure systems.

Uses: Suitable for all types of construction where durability is not a factor; furniture and cabinet work, flooring, joinery, millwork, veneer and plywood, and turnery.

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3. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. U.S. Department of Agriculture, Agriculture Handbook No. 207.
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CARINIANA PYRIFORMIS
and CARINIANA SPP.

ALBARCO, JEQUITIBA

Family: Lecythidaceae

Other Common Names: Abarco (Colombia), Bacú (Venezuela), Cerú, Jequitibá rosa, Jequitibá amarella, Tauary (Brazil).

Distribution: A genus of about 10 species distributed from eastern Peru and northern Bolivia through central Brazil to Venezuela and Colombia. Very common in forests of northern Colombia growing on lower slopes and well-watered valleys.

THE TREE A large tree, frequently 100 to 130 ft in height, with trunk diameters often 4 to 6 ft in diameter; boles are clear to 80 ft; large buttresses; well-formed stems.

THE WOOD General Characteristics: Heartwood reddish- or purplish-brown, sometimes with dark streaks usually not sharply demarcated from the pale brown sapwood; luster medium; texture medium; grain straight to interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.46; air-dry density 35pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	13,800	1,410	7,100
Green (1)	10,200	1,530	4,620
15%	12,500	--	6,320

Air-dry Janka side hardness 1,020 lb. Amsler air-dry toughness is 195 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries rapidly with only a slight tendency to warp or check. Kiln schedule T3-D2 is suggested for 4/4 stock and schedule T3-D1 for 8/4. Shrinkage green to oven-dry: radial 2.8%; tangential 5.4%; volumetric 9.0%. Reported to have good dimensional stability after manufacture.

Working Properties: Working properties generally satisfactory with only a slight blunting effect on cutting edges; but species in this grouping are also reported to cause rapid dulling of cutters. Silica is estimated to be in excess of 0.05%. Veneers reported to be cut without difficulty.

Durability: Heartwood reported to be durable, particularly deeply colored material; has good resistance to dry-wood termite attack.

Preservation: Heartwood is reported to be extremely resistant to preservative treatment; sapwood is permeable.

Uses: General construction and carpentry, furniture components, shipbuilding, flooring, veneer for plywood, and turnery.

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CARYOCAR SPP.

PIQUIÁ, CAGÜÍ

Family: Caryocaraceae

Other Common Names: C. villosum: Ajillo (Costa Rica), Pekia (Guayana), Sawarie (Surinam), Almendro (Peru), Piquiá (Brazil); C. costarricense: Ají (Costa Rica), Cagüí, almendrillo, almendrón (Colombia).

Distribution: Commercial species of the genus found in Costa Rica and southward into northern Colombia, upland forests of the Amazon valley, to eastern Brazil and the Guianas.

THE TREE Attains heights of 120 to 150 ft and diameters of 5 to 7 ft (16 ft reported) in the Amazon valley; 3- to 4-ft diameters reported in Colombia. Logs of good form and clear to 70 ft.

THE WOOD General Characteristics: Heartwood yellowish to light grayish-brown hardly separable from the sapwood. Texture medium to rather coarse; grain interlocked; fresh material with a mild vinegary scent but without odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume) 0.67 to 0.76; air-dry density 51 to 58 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	12,450	1,820	6,290
12%	17,060	2,160	8,410

Janka side hardness 1,720 lb for both green and dry material. Forest Products Laboratory toughness average for green and dry material is 150 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Air dries at a slow rate, warping and checking develop but only to a minor degree. Classified as moderately difficult to difficult to season. No kiln schedules available. Shrinkage green to ovendry: radial 5.0%; tangential 8.0%; volumetric 13.0%.

Working Properties: Reported as easy to moderately difficult to saw; rapid dulling of cutting edges; radial faces difficult to finish smoothly because of interlocked grain.

Durability: Heartwood rated as very durable in resistance to both brown-rot and white-rot fungi; classified as resistant to dry-wood termites and moderately resistant to marine borers.

Preservation: No data available on treatability. The wood is rated fair in its resistance to weathering (based on laboratory exposure tests) which contradicts its favorable reputation in the tropics.

Uses: General and marine construction, heavy flooring, railway crossties, boat parts, furniture components, especially suitable where hardness and high wear resistance are needed. Tree produces a large edible fruit (when cooked) which contains an oil-producing nut used for culinary purposes.

ADDITIONAL READING

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1971. 25 madeiras da Amazonia de valor comercial, caracterizaçao, macroscopica, usos comuns, e indices qualificativos. Publicaçao, Inst. de Pesqu. Tec. São Paulo No. 798.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

CATOSTEMMA SPP.

BAROMALLI

Family: Bombacaceae

Other Common Names: Arenillo (Colombia), Baramanni, Baramalli (Guayana), Flambeau rouge (French Guiana), Baraman (Venezuela), Kajoewaballi (Surinam).

Distribution: Carare-Opón and Serrania de San Lucas regions of Colombia; the Guianas, and in the low inundated forests near Manaus and northward in Brazil.

THE TREE On best sites may grow to 48 in. in diameter and 150 ft in height; commonly to heights of 100 ft and diameters of 24 in. Unbuttressed trees with long, clear, cylindrical trunks of excellent form.

THE WOOD General Characteristics: Heartwood dull yellowish- to pinkish-brown, distinct but not sharply demarcated from the yellowish-brown sapwood. Grain is straight to slightly interlocked; texture coarse; luster low; without distinctive odor or taste. Quartersawed surfaces show a distinctive "silver-grain" figure.

Weight: Basic specific gravity (ovendry weight/green volume) 0.50 to 0.60; air-dry density 36 to 46 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	8,100	1,610	3,840
12%	11,200	1,820	6,730
Green (4)	10,670	2,300	4,280
12%	15,450	2,880	8,340

Janka side hardness 520 lb for green and 720 lb for air-dry material with basic specific gravity of 0.50. Forest Products Laboratory toughness average for green and dry material is 166 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons rather slowly, degrade due to checking and warp is slight. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to oven dry: radial 5.2%; tangential 11.1%; volumetric 17.5%. Movement of timber in service is rated as large.

Working Properties: Rated as fair to poor in most machining operations but also reported to work easily with machine and hand tools. Machine-finished surfaces lack luster and are harsh to the touch. Takes glue well and can be nailed without splitting. Easy to cut into veneer.

Durability: Heartwood vulnerable to decay fungi and is rated as very susceptible to attack by dry-wood termites. Sapwood also susceptible to attack by powder-post beetles.

Preservation: Both heartwood and sapwood are easily impregnated with preservatives using either pressure or open-tank processes.

Uses: General construction work where dimensional stability is not critical, fiberboard, particleboard, plywood, box shook, and cooperage.

ADDITIONAL READING

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1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

CECROPIA PELTATA

TRUMPET-WOOD

Family: Moraceae

Other Common Names: Yagrumo (Cuba, Venezuela), Guarumo (Mexico, Colombia), Boessi papaja (Surinam), Imbaúba (Brazil), Cetico, Tacuna (Peru), Ambahú (Argentina).

Distribution: Throughout tropical America. Abundant in open areas and in forests, both virgin and cutover, often forming almost pure stands.

THE TREE A medium-sized tree with trunk diameters to 24 in. and height to 70 ft, more commonly 40-ft tall and 8 to 12 in. in diameter at maturity. Stems are hollow, often housing small stinging ants.

THE WOOD General Characteristics: No distinction between sapwood and heartwood, whitish when freshly cut becoming pale brown or oatmeal-colored upon exposure. Fairly lustrous; texture coarse; grain generally straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.26 to 0.34, air-dry density 20 to 26 pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second set based on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	4,040	860	1,870
12%	6,490	1,090	3,490
Green (2)	6,100	1,210	3,240
15%	8,800	--	4,300

Janka side hardness 220 lb for green and 320 lb for dry material. Forest Products Laboratory toughness 62 in.-lb at 12% moisture content (5/8-in. specimen). Both these tests on wood with basic specific gravity of 0.26.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons rapidly but with moderate to severe warp and little checking. The wood is also easy to kiln dry without excessive seasoning degrade. A modified schedule, T7-B6, is suggested for 4/4 stock and a modified T5-B5 for 8/4 (4). Shrinkage green to ovendry: radial 2.0%; tangential 6.2%; volumetric 8.3%.

Working Properties: Seasoned wood is very easy to saw and machine compared with green wood. Surfaces tend to tear and fuzz in shaping and turning but gives good results in planing and sanding. Nails readily and holds screws well. Difficult to finish with varnish or lacquer.

Durability: The wood is very susceptible to attack by decay fungi, termites, and other insects. Prone to blue stain.

Preservation: If incised or where there is high end-grain exposure, the wood will treat well using either pressure-vacuum systems or open tank.

Uses: Wood resembles North American black cottonwood in both density and mechanical properties. Used for plywood core stock, particleboard, matchsticks, boxes and crates, and excelsior. Neutral sulfite semichemical pulps were converted into bond papers of excellent brightness and appearance.

ADDITIONAL READING

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CEDRELA SPP.

SPANISH-CEDAR
CEDRO

Family: Meliaceae

Other Common Names: Cedro (Central and South America),
Acajou rouge (French West Indies), Cèdre rouge (French
Guiana), Ceder (Surinam).

Distribution: Cedrela occurs from Mexico to Argentina and
is found in all countries except Chile. Trees make their
best growth on rich, well-drained humid sites but may
also compete favorably on drier hillsides; intolerant
of water-logged locations.

THE TREE Under favorable conditions will reach heights over 100 ft
and diameters 3 to 6 ft above the substantial
buttresses. Straight cylindrical boles clear for
40 to 60 ft.

THE WOOD General Characteristics: Heartwood pinkish- to reddish-brown
when freshly cut, becoming red or dark reddish-brown,
sometimes with a purplish tinge, after exposure; sharply
to rather poorly demarcated from the pinkish to white
sapwood. Grain usually straight, sometimes interlocked;
texture rather fine and uniform to coarse and uneven;
luster medium to high and golden; distinctive cedar
odor usually pronounced, some specimens with bitter taste.

Weight: Basic specific gravity (ovendry weight/green volume)
very variable ranging from 0.30 to 0.60, averaging about
0.40; air-dry density ranges from 23 to 47 pcf, averaging
about 30 pcf.

Mechanical Properties: (First set of data based on 2-in.
standard; second set 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)* 12%	7,510 11,530	1,310 1,440	3,370 6,210
Green (2) 15%	9,100 11,750	1,200 --	4,080 5,650

Janka side hardness about 550 lb for green material
and 600 lb for air dry. Forest Products Laboratory
toughness average for green and dry material
106 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Easy to air season or kiln dry, slight warp with little or no checking. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. A 200° F heating for 8 to 17 hours at a relative humidity of 60 percent is suggested to control oil and gum exudates in service. Shrinkage green to ovendry: radial 4.2%; tangential 6.3%; volumetric 10.3%. Movement in service rated as small.

Working Properties: Cedro is easy to work with hand and machine tools but somewhat difficult to bore cleanly. Easy to cut into veneer but with some tendency for wooly surfaces to occur; good nailing and gluing properties; stains and finishes well but gums and oils sometimes are a problem in polishing.

Durability: Heartwood is rated as durable but there is some variability with species; resistant to both subterranean and dry-wood termites. Low resistance to attack by marine borers. Wood has excellent weathering characteristics.

Preservation: Heartwood is reported to be extremely resistant to preservation treatments. Reports on treatability of sapwood are conflicting.

Uses: Wood is favored for millwork, cabinets, fine furniture, musical instruments, boat building, patterns, sliced- and rotary-cut veneer, decorative and utility plywoods, cigar wrappers, and cigar boxes. Volatile oils may restrict use for some applications (e.g., clock cases).

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Instituto de Pesquisas Tecnologicas.
1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
3. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
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1952. Properties and uses of tropical woods, III. Tropical Woods No. 98:1-190.

CEDRELINGA CATENAEFORMIS

CEDRO-RANA
TORNILLO

Family: Leguminosae

Other Common Names: Tornillo (Peru), Iacaica, Paricá,
Yacayacá (Brazil).

Distribution: Reported in the Loreto and Huanuco Provinces
of Peru; encountered most frequently on slopes or
hillsides and in the humid "terra firma" of the
Brazilian Amazon region.

THE TREE A large tree 100 to 160 ft tall with a trunk diameter of
5 to 9 ft. Trees felled in Huanuco Province of Peru
were up to 4 ft in diameter with merchantable heights
of 45 ft and more.

THE WOOD General Characteristics: Heartwood pale brown with a golden
luster; prominently marked with dark red vessel lines;
merging gradually into the lighter-colored sapwood.
Texture coarse; roe grained; odor and taste absent in
dry specimens, but fresh-cut timber is reported to emit
a disagreeable scent when worked.

Weight: Basic specific gravity (ovendry weight/green volume)
reported to be about 0.53 for material collected in
Brazil and 0.41 for Peruvian stock. Air-dry density
respectively 40 and 31 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	7,600	1,377	3,610

*See "Additional Reading" for reference.

Drying and Shrinkage: No data available on drying characteristics. Volumetric shrinkage (green to oven dry): 11.8%.

Working Properties: Saws wooly but is easy to cut; can be finished smoothly.

Durability: Reported to be probably fairly durable; also reported to have good weathering resistance.

Preservation: No data available.

Uses: General construction, furniture components.

ADDITIONAL READING

1. Barefoot, A. C., and J. D. Traywick.
1971. Mechanical and related properties of tornillo (Cedrelina catenaeformis). *Wood Science* 3(4):245-253.
2. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.

CEIBA PENTANDRA

CEIBA
SILK-COTTON-TREE
KAPOK-TREE

Family: Bombacaceae

Other Common Names: Fromager (French West Indies), Pochota, Yaxché (Mexico), Bonga, Ceiba de lana (Colombia), Ceiba yuca (Venezuela), Sumaúma (Brazil), Toborochi (Bolivia).

Distribution: Throughout the tropical world; from the Tropic of Cancer in Mexico southward through Central America to Colombia, Venezuela, Brazil, and Ecuador. Also West Africa and Malay Peninsula. Characteristically an open-grown tree.

THE TREE A very large tree with a height of 150 ft and a diameter of 7 ft above the buttresses, which often are of plank form and wide spreading; the trunk, which is cylindrical or at times thicker in the middle, is smooth or covered with large conical spines.

THE WOOD General Characteristics: Heartwood pinkish-white to ashy-brown when dry and not clearly distinguished from the sapwood. Luster low; grain generally straight, sometimes irregular; texture coarse with a harsh feel; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.25; air-dry density 18pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
Green (4)*	2,180	410	1,060
12%	4,330	540	2,380
15% (1)	3,980	--	2,490

Janka side hardness 220 lb for green wood and 240 lb for dry. Forest Products Laboratory toughness average for green and dry material is 24 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries rapidly with little warp or checking; also easy to kiln dry. Kiln schedule T10-D5S is suggested for 4/4 stock and schedule T8-D4S for 8/4. Shrinkage green to ovendry: radial 2.1%; tangential 4.1%; volumetric 7.7%. Movement in service is rated small.

Working Properties: The wood is easy to machine but not satisfactorily; sawed surfaces are fuzzy; tears the grain in shaping, boring, turning, and mortising, but gives excellent results in planing and sanding. Poor nail and screw holding properties. Easy to peel into veneers.

Durability: Laboratory tests indicate nondurable to white-rot fungus attack but durable to very durable when exposed to brown rot. Rated as extremely vulnerable to decay when in ground contact, also very susceptible to insect attack. Logs and lumber often discolored by sap-staining fungi.

Preservation: Easy to treat with good absorption and penetration using either pressure-vacuum systems or open tank methods.

Uses: Plywood, packaging, lumber core stock, light construction, pulp and paper products, also used locally for canoes and rafts. Floss on seeds (kapok) harvested for use in buoys, life belts, stuffing pillows, and similar articles.

ADDITIONAL READING

1. Japing, H. W.
1957. [Tests of the most important mechanical and physical properties of 41 Surinam wood species.] Meded. Inst. trop. Amst. No. 122 (Afd. trop. Prod. No. 46).
2. Laboratorio Nacional de Productos Forestales.
1974. Caracteristicas, propiedades, y usos de 104 maderas de los altos llanos. Universidad de Los Andes, Merida.
3. Villamil G., F. (ed.).
1971. Maderas colombianas. Proexpo, Bogotá.
4. Wangaard, F. F., A. Koehler, and A. F. Muschler.
1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

CENTROLOBIUM SPP.

ARARIBA
PORCUPINE WOOD
CANARY WOOD

Family: Leguminosae

Other Common Names: Amarillo guayaquil (Panama, Ecuador),
Guayacan hobo, Balaústre (Colombia, Venezuela),
Araraúba, Araraúva (Brazil), Morosimo (Paraguay).

Distribution: Five or six species of rather infrequent occurrence from Panama to Ecuador and southern Brazil.

THE TREE A medium-sized to large well-formed tree; generally up to 100 ft high with diameters of 30 to 50 in.; commonly to heights of 40 ft and diameters to 16 in. Narrow buttresses to heights of 3 ft in some species.

THE WOOD General Characteristics: Heartwood yellow or orange, typically variegated, sometimes "rainbow hued", usually changing to red or brown; rather sharply demarcated from the yellowish sapwood. Luster medium to high; texture fine to rather coarse; grain straight to irregular; some species without odor or taste, others with distinctive odor and sometimes with perceptible taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.61 to 0.69; air-dry density 46 to 53 pcf.

Mechanical Properties: (First set of data based on 2-cm standard, second set on 1-in. standard, and third on 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	14,200	1,500	5,900
15%	16,800	--	7,900
12% (<u>1</u>)	18,600	2,130	9,550
12% (<u>3</u>)	17,200	2,440	--

Janka side hardness 1,030 lb for dry wood. Amsler toughness 288 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to have a moderate drying rate with little to no warp or checking. Kiln schedule T6-D2 is suggested for 4/4 stock of C. ochroxylon and T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.4%; tangential 5.6%; volumetric 8.4%.

Working Properties: The wood is easy to machine with all tools; finishing very smoothly but there may be some fuzzy grain on planing of radial surfaces.

Durability: The wood is reported to be highly resistant to attack by decay fungi, termites and other insects, and marine borers (*teredo*).

Preservation: Impregnation with wood preservatives is only moderate using pressure-vacuum systems, absorption and penetration is negligible using the open-tank method.

Uses: Heavy construction, railroad crossties, fine furniture and cabinet work, flooring, ship components (planking, keel, decking, and trim), turnery, decorative veneers, cooperage.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Instituto de Pesquisas Tecnologicas.
1956. Tabelas de resultados para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
3. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

CHLOROPHORA TINCTORIA

FUSTIC

MORA AMARILLA

Family: Moraceae

Other Common Names: Bois d'orange (Trinidad), Barossa, Moral (Mexico), Palo de mora (Costa Rica), Dinde, Palo amarillo (Colombia), Mora (Venezuela), Insira (Peru), Amarillo (Bolivia), Taiúva, Amarello (Brazil), Tatayivá-saiyú (Argentina).

Distribution: Widely distributed throughout Tropical America. A northern form is found in coastal lowlands of southern Mexico, Central America, the West Indies, and northern South America. A southern form is found in Misiones (Argentina), Paraguay, and southern Brazil, but nowhere abundant.

THE TREE Forest-grown trees are well formed, frequently 20 to 24 in. in diameter and 60 to 80 ft high with a clear trunk of 20 to 35 ft. In certain areas the trees attain diameters of 40 in. and heights of 90 to 120 ft. Open-grown trees are short, branchy, and often with a crooked bole.

THE WOOD General Characteristics: Fresh heartwood is bright yellow, drying to golden-yellow, changing upon exposure to brown or russet, sometimes with a reddish tinge; sharply demarcated from the nearly white sapwood. Luster high; texture usually fine; grain variable, often interlocked; odor and taste lacking or not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) 0.71 to 0.78; air-dry density 52 to 60 pcf.

Mechanical Properties: (First set of data based on 2-in. standard, second on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	14,840	1,590	6,860
12%	19,560	2,160	11,080
Green (1)	20,000	1,920	9,700
15%	21,600	--	11,900

Janka side hardness 2,190 lb for green material and 2,380 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 229 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries at a moderate to fast rate with only slight checking and warping. No data on kiln drying available but air drying followed by a mild kiln schedule is suggested. Despite its high density, the wood has exceptionally low shrinkage. Shrinkage green to ovendry: radial 3.4%; tangential 5.4%; volumetric 7.8%.

Working Properties: The wood is somewhat difficult to work with hand and power tools but finishes smoothly and glues well.

Durability: Heartwood very durable in resistance to both white-rot and brown-rot fungi and also has excellent weathering characteristics. The heartwood is also rated as highly resistant to dry-wood termites. Data on resistance to marine-borer attack are conflicting.

Preservation: The heartwood is not responsive to preservation treatments; sapwood should treat satisfactorily if incised.

Uses: Heavy construction, decking, planking, and framing for boats, exterior and interior flooring, turnery, furniture parts, tool handles, railroad ties, and wood tanks. Also contains the coloring maclurin long used as a yellowish brown or khaki dye.

ADDITIONAL READING

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Universidad de Los Andes, Merida.
3. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.
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1952. Properties and uses of tropical woods, III.
Trop. Woods No. 98:1-190.

CLARISIA RACEMOSA

OITICICA AMARELA

AJI

Family: Moraceae

Other Common Names: Caraco, Aji, Arracacho (Colombia), Matapalo (Ecuador), Chichillica (Peru), Guaruba, Oity (Brazil).

Distribution: Widely distributed in Brazil and extends into northeastern Peru, the Serrania de San Lucas region of Colombia, and the Venezuelan Guiana; grows scattered or in small clumps.

THE TREE Attains a height of 130 ft with a well-formed nonbuttressed trunk sometimes 36 in. in diameter and free of branches for 50 to 60 ft.

THE WOOD General Characteristics: Heartwood bright yellow, becoming brown or russet, but retaining a golden luster upon exposure; sharply defined from the thin white sapwood. Texture medium to coarse; grain variable, often decidedly roey with attractive figure; dry specimens without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) averages about 0.53; air-dry density 40pcf.

Mechanical Properties: (First set of data based on 2-cm standard, second on 1-in. standard, and third on 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	10,400	1,150	5,350
15%	11,600	--	--
12% (<u>2</u>)	16,700	2,340	9,620
12% (<u>1</u>)	18,000	2,360	9,070

Janka side hardness averages about 1,400 lb for dry material. Forest Products Laboratory toughness 159 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries rapidly. No data on degrade or on kiln schedules. Shrinkage green to ovendry: radial 2.9%; tangential 6.1%; volumetric 9.0%. Reported to have good stability when manufactured.

Working Properties: Easy to work and is rated fair to good in all machining operations. Cross-grained material requires sharp tools to produce a smooth surface; fresh wood saws wooly.

Durability: Tentative field trials in Venezuela indicate heartwood to be durable and resistant to termite attack. Elsewhere the wood is rated not very durable in ground contact.

Preservation: Heartwood not responsive to treatment by pressure-vacuum systems or by open tank. Sapwood treatable if incised.

Uses: General construction, flooring, and furniture components.

ADDITIONAL READING

1. Falla Ramirez, A.
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2. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

CLATHROTROPIS spp.

AROMATA

Family: Leguminosae

Other Common Names: Alma negra, Sapan (Colombia), Cabarí, Timbó pau, Timbó rana (Brazil).

Distribution: Several species distributed in the Guianas, central and northern Amazon region, and into the Magdalena Valley of Colombia.

THE TREE The trees are unbuttressed but basally swollen, usually 16 to 20 in. in diameter and 90 to 100 ft tall; the main stem often clear for 40 ft and more. Diameters of 4 to 5 ft are reported in Trinidad. Trees thrive in swampy areas and on hillsides having high rainfall.

THE WOOD General Characteristics: The sapwood is thick, sharply defined, yellowish to brownish-white. Heartwood is pinkish-brown to dark brown streaked with light-colored parenchyma bands. Grain is straight to irregular; texture medium to very coarse; luster medium to dull; odorless and tasteless.

Weight: Basic specific gravity (ovendry weight/green volume) averages from 0.80 to 0.97; air-dry density 60 to 75 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	23,100	--	16,500
12% (1)	28,600	3,500	13,900

Janka side hardness at 12% moisture content 2,960 lb.

*See "Additional Reading" for references.

Drying and Shrinkage: Wood is moderately difficult to dry with a tendency to warp and check. No data on kiln schedules available. Shrinkage green to ovendry: radial 5.0%; tangential 6.7%; volumetric 11.9%.

Working Properties: The wood is reported to be difficult to saw and difficult to work on all machines except dresses well in planing and sanding. The wood finishes smoothly and takes a high polish; easy to glue.

Durability: Reported to be moderately to highly resistant to attack by decay fungi; moderately resistant to subterranean termites, and probably has moderate to low resistance to marine borers.

Preservation: No data available, heartwood probably not treatable.

Uses: Heavy construction, furniture components, and flooring.

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1. Falla Ramirez, A.
1971. Resultados de estudios físico-mecánicos de algunas maderas de la Serranía de San Lucas. Plegable Divulgativo, División Forestal. INDERENA, Bogatá.
2. Falla Ramirez, A.
1971. Resultados de los estudios físico-mecánicos de 41 especies maderables de la region Cararé-Opon. Plegable Divulgativo, División Forestal. INDERENA, Bogatá.
3. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.

COPAIFERA SPP.

COPAIBA

Family: Leguminosae

Other Common Names: Copaiba (generally in Latin America), Camiba, Cabino blanco (Panama), Cabimo, Palo de aceite (Venezuela), Canime, Copaiba (Colombia), Copaibarana, Copahyba (Brazil), Cupay (Paraguay), Timbó-y-atá (Argentina).

Distribution: Varies with species and ranges from Panama southward to Argentina and Paraguay. C. reticulata has wide distribution in the Amazon region and is the source of copaiba balsam.

THE TREE May reach a height of 100 ft and a trunk diameter of 4 ft.

THE WOOD General Characteristics: Heartwood reddish-brown, variable often with a coppery hue, and sometimes streaked; not very sharply demarcated from the pinkish-gray or nearly white sapwood. Luster rather silky and golden; grain usually straight; texture medium; oily exudations sometimes present, the woods of all species contain gum or oil canals. Dry material without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.46 to 0.64; air-dry density 34 to 49 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, the second on the 2-cm standard, and the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	12,980	2,270	6,070
12%	21,200	2,650	10,700
Green (<u>1</u>)	8,580	1,350	3,900
15%	11,300	--	5,980
12% (<u>2</u>)	12,900	--	6,500

Janka side hardness 1,390 lb for green material, 1,740 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 204 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to have a slow to moderate rate of drying. C. aromatica air dried with bow being the only degrade. No information available on kiln schedules. Shrinkage green to oven dry: radial 4.4%; tangential 9.2%; volumetric 14.6%.

Working Properties: The wood is easy to work and finishes very smoothly; a small amount of material showed fuzzy grain after planing.

Durability: C. officinalis is reported to be vulnerable to attack by decay fungi, insects, and drywood termites. C. aromatica and other species are reported to be highly durable.

Preservation: C. officinalis heartwood as well as other species difficult to very difficult to preserve using pressure-vacuum systems; good absorption and penetration of sapwood is reported.

Uses: Carpentry, general construction, interior trim, furniture, turnery, suggested for particleboard and excelsior cement board. Trees are highly valued for its gum or balsam.

ADDITIONAL READING

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FO-UNDP/SF PAN/6. FAO. Rome.
4. Wangaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V.
Trop. Woods No. 103:1-139.

CORDIA SPP.
(HARD-WOODED, DARK-COLORED GERASCANTHUS GROUP)

CANALETE

Family: Boraginaceae

Other Common Names: Anacahuite, Baria (Cuba), Siricote, Bocote, Cupané, Amapa asta (Mexico), Canalete (Colombia, Venezuela), Louro pardo (Brazil), Loro negro (Argentina).

Distribution: The several species of this group are found in northern Florida, West Indies, Central America, and southward to Brazil and Argentina.

THE TREE A small to large tree, sometimes 100-ft tall. In Mexico the trees are found in Tropical Dry zones with precipitation of about 1,000 mm and up to 500 m elevations.

THE WOOD General Characteristics: Heartwood tobacco-colored to reddish-brown, with irregular dark brown or blackish streaks and variegations, with more or less of an oily or waxy appearance; rather sharply demarcated from the grayish or yellowish sapwood. Luster variable; texture fine to medium; grain variable; taste not distinctive; scent mildly fragrant, at least when fresh.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.63 to 0.84; air-dry density 48 to 65 pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second set on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	13,700	1,390	--
12%	15,700	1,580	--
Green (2)	13,700	1,760	6,500
15%	18,500	--	9,000

Janka side hardness 2,200 lb for air-dry material. Amsler toughness 340 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is difficult to dry; readily develops surface checking and end splitting. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.0%; tangential 7.4%; volumetric 11.6%. Holds its place well when manufactured.

Working Properties: A readily worked timber, finishing very smoothly.

Durability: Durability is rated high.

Preservation: No data available.

Uses: Fine furniture, cabinet work, turnery, flooring, rotary and sliced veneer, and rifle stocks.

ADDITIONAL READING

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1969. Algunas caracteristicas tecnologicas de la madera de once especies Mexicanas. Bol. tec. Inst. Nac. Invest. For. Mexico No. 27.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

CORDIA SPP.
(SOFT-WOODED, LIGHT-COLORED ALLIODORA GROUP)

FREIJO
LAUREL BLANCO
PETEREBI

Family: Boraginaceae

Other Common Names: C. goeldiana: Freijo, Frei jorge (Brazil); C. alliodora: Laurel blanco, Pardillo (Venezuela), Bojón (Mexico), Canalete (Colombia), Louro (Brazil); C. trichotoma: Peterebi (Argentina).

Distribution: The several commercial species have a range that includes southern Mexico to the southern edge of the tropics in South America. Freijo is found in the Atlantic zone of Pará and in the Tocantins and Xingu River basins of Brazil.

THE TREE Varies in size in different regions; frequently 40 to 60 ft in height with diameters of 18 to 24 in.; in areas of optimum growth it attains diameters of 36 in. and heights of 120 ft. Narrow buttresses are commonly 6 ft or less in height, but not present in C. trichotoma.

THE WOOD General Characteristics: Heartwood yellowish to brown, uniform or more or less streaked and variegated; light-colored material not clearly differentiated from sapwood. Luster is medium to high often rich and golden; texture very variable from fine to coarse; grain usually straight to shallowly interlocked; dark-colored specimens have spicy scent otherwise without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.44 to 0.52; air-dry density 34 to 40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	9,050	1,280	4,040
12%	12,180	1,510	6,330
Green (4)	10,540	1,830	4,940
12%	14,700	2,090	7,240

Janka side hardness averages about 910 lb for green material and about 1,000 lb for dry. Forest Products Laboratory toughness ranged from 138 in.-lb to 195 in.-lb, averages for green and dry material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons rapidly with only slight warping and checking. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 3.4%; tangential 7.1%; volumetric 9.2% (C. alliodora). Holds in place well after manufacture.

Working Properties: The wood is easy to work and finishes smoothly; readily glued.

Durability: The heartwood is rated as durable upon exposure to both white-rot and brown-rot fungi but degree of durability appears to be related to the coloring of the wood. Also reported to have good resistance to dry-wood termites. The wood has good weathering characteristics and absorbs moisture at a moderate rate. Not resistant to attack by marine borers in some areas, but C. alliodora is reported to have high resistance in Panama waters.

Preservation: Heartwood is not receptive to preservation treatments; sapwood absorption is adequate but with marginal penetration.

Uses: General construction, millwork, fine cabinet and furniture components, flooring, decorative veneer, cooperage, boat construction; for some applications used as a substitute for teak, walnut, or mahogany.

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COUMA MACROCARPA

COW TREE

Family: Apocynaceae

Other Common Names: Perillo negro, Avichuri (Colombia), Guaimaro macho, Vacahosca (Venezuela), Dukaballi (Guyana), Ama-apa (Surinam), Leche-caspi (Peru), Cumá assú, Sorva (Brazil).

Distribution: An Amazonian species but also found in the Cararé-Opón and Serranía de San Lucas regions of the Río Magdalena in Colombia. Found mostly in low areas.

THE TREE Total tree heights 60 to 80 ft, with trunk diameters of 20 to 24 in.; straight, well-formed stems.

THE WOOD General Characteristics: Wood cream-colored or pale brown, often with a pinkish tinge; no sharp demarcation between sapwood and heartwood. Grain fairly straight to interlocked; texture medium; luster rather low to medium; odor and taste not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) 0.50, air-dry density 38 pcf.

Mechanical Properties: (First set of data based on 2-cm standard; second set based on 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	16,700	--	9,280
12% (2)	15,900	--	7,100

Janka side hardness 980 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: This wood is easy to both air dry and kiln dry with little or no degrade due to warping or checking. No kiln schedules available. Shrinkage green to ovendry: radial 3.9%; tangential 6.4%; volumetric 10.4%.

Working Properties: The wood is easy to work with all tools, however there is some difficulty to generate smooth surfaces on quarter-sawn stock due to the interlocked grain. Easy to nail and screw.

Durability: Natural durability is low and prone to attack by blue-stain fungi.

Preservation: No data available but suggested uses in Colombia indicate the wood is responsive to preservation treatments.

Uses: Interior millwork, general construction, furniture components, veneer for plywood, particleboard and fiberboard, boxes, and crates.

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COURATARI spp.

MAHOT
TAUARY

Family: Lecythidaceae

Other Common Names: Congolo-Garapelo (Panama), Tabarí, Tauari (Venezuela), Coco Cabuyo (Colombia), Ingiepipa (Surinam), Tauary (Brazil).

Distribution: Several commercial species extending from Costa Rica and Panama southward to the Guianas and Brazilian Amazon.

THE TREE Up to 120 ft high with trunk diameters 3 to 4 ft; boles are well formed above the stout buttresses.

THE WOOD General Characteristics: Sapwood not distinct from the heartwood which is cream colored with a pinkish or yellowish tinge. Luster rather low to high; grain straight or uniformly interlocked; texture medium to coarse; luster high; odor and taste usually lacking, odor reported as fetid in some species. Silica to 0.8% reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.50; air-dry density 37pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	9,240	1,730	4,260
12%	13,520	1,800	7,460
12% (<u>1</u>)	17,200	--	8,650
15% (<u>3</u>)	14,200	1,730	7,600

Janka side hardness 880 lb at 12% moisture content and 740 lb for green material. Forest Products Laboratory toughness average for green and dry material is 124 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Wood has a moderate rate of drying with slight surface checking and warp. No dry kiln schedule data available. Shrinkage green to ovendry: radial 4.1%; tangential 7.3%; volumetric 11.3%.

Working Properties: The wood is rated fair to good in all machining operations. High silica content in some species requires specially tipped cutters.

Durability: Considerable variability of heartwood resistance to decay fungi is reported, from durable to nondurable. Some species show fair resistance to marine borer attack.

Preservation: Heartwood and sapwood easily treated by both pressure and open tank systems with good absorption and penetration.

Uses: General interior construction and carpentry work, boxes and crates, furniture components, veneer and plywood, and railroad crossties (treated).

ADDITIONAL READING

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Trop. Woods No. 98:1-190.

CUPRESSUS LUSITANICA

MEXICAN CYPRESS

Family: Cupressaceae

Other Common Names: Ciprés (Latin America).

Distribution: Native to Mexico and probably Guatemala but now widely planted at high elevations throughout the tropical world.

THE TREE Height growth may exceed 100 ft with a bole diameter of 2 to 3 ft, sometimes reaching 5 ft. Logs are usually well-shaped, straight, and cylindrical.

THE WOOD General Characteristics: Heartwood yellowish, pale brown, or pinkish, sometimes streaked or variegated; sapwood paler, usually sharply demarcated. Grain straight to irregular; texture fine and uniform; luster rather high; fragrantly scented.

Weight: Basic specific gravity (ovendry weight/green volume) 0.43; air-dry density 32 pcf.

Mechanical Properties: (2-in. standard; plantation grown)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	<u>Psi</u>	<u>1,000 psi</u>	<u>Psi</u>
12% (1)*	12,400	1,390	5,820
Green (3)	6,160	925	2,880
12%	10,270	1,020	5,380

Janka side hardness 340 lb for green material and 460 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries very rapidly with little or no end or surface checking and only slight warp. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: volumetric 8.0%.

Working Properties: The wood is easy to work with hand and machine tools, easy to nail, and stains and polishes well.

Durability: Reports on durability are conflicting.

Preservation: The heartwood is reported to be not treatable by the open tank process and having an irregular response to pressure-vacuum systems. Treatment may be improved considerably by incising.

Uses: Posts and poles, furniture components, and general construction.

ADDITIONAL READING

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Utilization Section, Forest Division, Moshi,
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CYBISTAX DONNELL-SMITHII
SYN. TABEBUIA DONNELL-SMITHII

PRIMAVERA

Family: Bignoniaceae

Other Common Names: Duranga (Mexico), San Juan (Honduras),
Palo blanco (Guatemala), Cortez, Cortez blanco
(El Salvador).

Distribution: Southwestern Mexico, Pacific coast of Guatemala
and El Salvador, and north central Honduras. Occurs in
mixed forests on well-drained limestone, volcanic, or
alluvial soils from sea level to an elevation of about
800 ft.

THE TREE Attains a height of 100 ft, commonly with trunk diameters of
2 to 3 ft, occasionally 4. Bole is clear and smooth
24 to 40 ft.

THE WOOD General Characteristics: The wood is cream colored, yellowish-
white to pale yellowish-brown, often more or less striped.
Sapwood not clearly demarcated, slightly paler than the
heartwood. Grain straight to roey; texture medium to
rather coarse, uniform; luster fairly high; odorless and
tasteless.

Weight: Basic specific gravity (ovendry weight/green volume)
0.40; air-dry density 29pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	7,180	990	3,510
12%	9,530	1,040	5,600

Janka side hardness about 680 lb for both green and
dry material. Forest Products Laboratory toughness
average for green and dry material is 75 in.-lb
(5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Wood is easy to air season, drying rapidly with no checking and only slight warp. A modified kiln schedule T6-F3 is suggested for 4/4 stock (3). Shrinkage green to ovendry: radial 3.1%; tangential 5.1%; volumetric 9.1%. Holds its place well after manufacture.

Working Properties: The wood is easy to work in all operations even though there may be considerable grain variation; finishes smoothly and acquires an attractive polish. Produces a good quality veneer.

Durability: Laboratory tests indicate a variable resistance to both brown-rot and white-rot fungi, similar to field observations. Weathering characteristics are good.

Preservation: No data available on treatability.

Uses: Fine furniture, cabinet work, decorative veneers, and interior trim.

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Trop. Woods No. 98:1-190.

CYNODENDRON SPP.
and CHRYSOPHYLLUM SPP.

CAIMITO
STAR-APPLE

Family: Sapotaceae

Other Common Names: Caimitillo, Lechecillo (Puerto Rico),
Canela (Mexico), Caimito morado (Venezuela),
Kokoritiballi (Guyana), Balata blanca (Peru),
Massaranduba-rana (Brazil), Aguay, Carne de Vaca (Argentina).

Distribution: Widely distributed in tropical and subtropical regions with various species found in southern Mexico to Misiones, Argentina.

THE TREE Often small to medium-sized tree 35 to 65 ft high, but sometimes 75 to 100 ft; trunk diameters up to 24 in. An attractive ornamental and shade tree widely planted (Chrysophyllum cainito).

THE WOOD General Characteristics: Heartwood variable in color from pale brown or pinkish to rather dark brown, with gradual transition to the sapwood. Luster rather low to medium; texture fine to medium; grain fairly straight; odor and taste absent or not distinctive. A silica content of over 0.84% is reported (C. maytenoides).

Weight: Basic specific gravity (ovendry weight/green volume) mostly from 0.60 to 0.90; air-dry density 50 to 70 pcf.

Mechanical Properties: (1-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	20,000	--	11,500
12% (1)	23,200	3,300	12,600

Forest Products Laboratory toughness at 12% moisture content 128 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries somewhat slowly and air drying prior to kiln drying is suggested. No kiln schedule data available. Shrinkage green to ovendry: radial 6.4%; tangential 8.6%; volumetric 15.2%.

Working Properties: A notably hard and abrasive wood that requires wear-resistant cutters for satisfactory machining; can be finished smoothly.

Durability: The Venezuelan species are reported to be vulnerable to attack by decay fungi as well as termites.

Preservation: Heartwood treats poorly by both pressure-vacuum and open tank systems. Sapwood should have adequate treatment if incised.

Uses: General construction, carpentry, furniture, and turnery. C. cainito is favored for its edible fruit.

ADDITIONAL READING

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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

DACRYODES EXCELSA

GOMMIER
CANDLE TREE

Family: Burseraceae

Other Common Names: Tabonuco (Puerto Rico), Gommier blanc (Guadeloupe), Gommier montagne (Martinique).

Distribution: Puerto Rico and Lesser Antilles from St. Kitts to Grenada. Generally in small groups along upper slopes, but forms almost pure stands at high elevations in Dominica.

THE TREE Reaches a height of 100 ft or more and diameters of 3 to 5 ft; straight well-formed clear boles; unbuttressed.

THE WOOD General Characteristics: Heartwood is a uniform pale brown with a purplish cast when first cut turning to a lustrous pinkish-brown when seasoned, resembling mahogany; clearly demarcated from narrow grayish sapwood. Texture fine to medium; grain more or less roey with attractive ribbon stripe; odor and taste lacking. Silica content of 0.50% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	9,330	1,200	4,530
12%	13,030	1,530	7,150

Janka side hardness 690 lb for green material and 900 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood air seasons easily with only minor degrade in the form of slight warp and end checking and with no apparent surface checking. No dry kiln data available. Shrinkage green to ovendry: radial 4.1%; tangential 6.4%; volumetric 10.5%.

Working Properties: A moderately good machining wood; cuts and saws easily but because of an abundance of silica, rapidly dulls saw teeth and other cutting edges. The wood finishes smoothly and is easy to lacquer or varnish.

Durability: The heartwood is only slightly resistant to attack by decay fungi when in ground contact and is very susceptible to attack by dry-wood termites; not resistant to marine borer attack.

Preservation: The heartwood and sapwood are difficult to treat with preservatives by either pressure or non-pressure methods. Incising improves absorption of sapwood.

Uses: Furniture and cabinet work, possible veneer wood, general construction. The trees are scarred near the base to obtain a fragrant resin exudate used to make candles and for medicinal purposes.

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DALBERGIA NIGRA

BRAZILIAN ROSEWOOD
JACARANDÁ

Family: Leguminosae

Other Common Names: Palissandre du Brésil (French), Jacaranda de Brasil (Spanish), Cabiuna, Caviuna, Jacarandá (Brazil).

Distribution: Of scattered occurrence in the eastern forests of the State of Bahia and southward to Espírito Santo and Rio de Janeiro and inland to include Minas Gerais. Because of long-time exploitation, the tree has become very scarce in the more accessible regions.

THE TREE Sometimes attains a height of 125 ft, with short irregular bole, often buttressed, trunk diameters 3 to 4 ft. Old trees are generally hollow and also lose much of their volume when the undesired sapwood is hewed off. Old defective stems yield the most attractive wood.

THE WOOD General Characteristics: Heartwood in various shades of brown to chocolate or violet, irregularly and conspicuously streaked with black; dark specimens with oily or waxy appearance and feel; sharply demarcated from the white sapwood. Grain generally straight; texture medium to rather coarse; luster medium; fragrant rose-like odor, taste distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.62 to 0.73; air-dry density 47 to 56 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	14,140	1,840	5,510
12%	18,970	1,880	9,600

Janka side hardness 2,440 lb for green material and 2,720 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 151 in.-lb (5/8-in. specimen). Above values for a Brazilian Dalbergia with a basic specific gravity of 0.80.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber needs to be dried slowly to prevent checking. Once seasoned it absorbs moisture slowly and is dimensionally stable in service. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 2.9%; tangential 4.6%; volumetric 8.5%.

Working Properties: This wood has excellent working properties and veneers well. Some specimens may be too oily to take a good polish.

Durability: Heartwood is very resistant to decay and insect attack.

Preservation: No data available (the uses of this species are such that a preservation treatment would not be desirable even if the wood would be receptive).

Uses: Decorative veneers, fine furniture and cabinets, parts of musical instruments, brush backs, knife and other handles, fancy turnery, piano cases, marquetry.

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DALBERGIA RETUSA

COCOBOLLO

Family: Leguminosae

Other Common Names: Granadillo (Mexico, Guatemala), Funera (El Salvador), Palo negro (Honduras), Nambar (Nicaragua, Costa Rica), Cocobolo, Cocobolo prieto (Panama).

Distribution: Pacific regions of Central America and extending from Panama to southwestern Mexico. Of limited occurrence, usually in the drier uplands.

THE TREE A small to medium-sized tree 45 to 60 ft high with trunk diameters of 20 to 24 in.; usually of poor form.

THE WOOD General Characteristics: Somewhat variable in color when freshly sawn but heartwood usually becoming a deep rich orange-red with black striping or mottling on exposure. Texture fine; grain straight to interlocked; oily; without distinctive taste, odor slightly pungent and fragrant when worked. Fine dust may cause dermatitis.

Weight: Basic specific gravity (ovendry weight/green volume) 0.80 to 0.98; air-dry density 62 to 76 pcf.

Mechanical Properties: No data available, but is denser and stronger than Brazilian rosewood (see D. nigra).

Drying and Shrinkage: Reported to have excellent drying properties, free of surface and end checking. A kiln schedule similar to T1-B1 has been suggested. Shrinkages usually low; high stability in use. Very low moisture absorption.

Working Properties: Reported to have excellent machining characteristics; natural oils give the wood a good polish, but make it unsuitable for gluing. Fine dust may produce rash resembling ivy poisoning.

Durability: Durability is high, has very high resistance to marine borer attack.

Preservation: No data available.

Uses: Highly favored in the cutlery trade for handles, inlay work, high quality turnery, small tool handles, brush backs, musical and scientific instruments, jewelry boxes, chessmen, and other specialty items.

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DALBERGIA STEVENSONII

HONDURAS ROSEWOOD

Family: Leguminosae

Other Common Names: Palissandre du Honduras (French),
Palisandro de Honduras (Spanish), Honduras Rosenholz
(German).

Distribution: Reported only in Belize (British Honduras)
occurring in fairly large patches along rivers but
also on inter-riverain and drier areas; mostly between
Sarstoon and Monkey Rivers.

THE TREE Attains a height of 50 to 100 ft, with trunk diameters to
3 ft. Boles are often fluted and short, commonly
forked at about 20 to 25 ft from the ground.

THE WOOD General Characteristics: Heartwood is pinkish-brown to
purple with alternating dark and light zones forming a
very attractive figure, distinct from 1- to 2-in.
thick yellow sapwood. Texture medium to rather fine;
grain generally straight to slightly roey; luster low
to medium; fresh wood has an aromatic odor which
dissipates with age, taste not distinctive to slightly
bitter.

Weight: Basic specific gravity (ovendry weight/green
volume) 0.75 to 0.88; air-dry density 58 to 68 pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: Reported to air dry slowly with a marked tendency to check. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage values similar to other American rosewoods which are unusually low. Holds its place well after manufacturing.

Working Properties: Moderately difficult to saw and machine due to its hardness, dulls cutting edges; tends to ride over cutters. Excellent for turning and finishes well if not too oily.

Durability: Heartwood is highly durable, reported to be moderately resistant to termites.

Preservation: No data available.

Uses: Parts of musical instruments including percussion bars of xylophones, veneers for fine furniture and cabinets, brush backs, knife handles, fine turnery, many specialty items.

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DENDRO PANAX ARBOREUS

ANGELICA TREE

Family: Araliaceae

Other Common Names: Pollo (Puerto Rico), Lengua de vaca (Dominican Republic), Mano de oso, Palo santo (Mexico), Nagua blanca, Vaquero (Panama), Quesito, Pama (Venezuela), Banco (Colombia), Maria molle (Brazil).

Distribution: Common and widespread in tropical America; West Indies, Mexico, and southward to Colombia, Venezuela, Peru, and Bolivia. Frequently used for shade in coffee plantations.

THE TREE Typically a small tree, rarely up to 75 ft in height with a trunk diameter up to 25 in.; wide-spreading crown.

THE WOOD General Characteristics: There is no color differentiation between heartwood and sapwood; cream-colored to grayish-yellow. Grain is straight; texture medium and uniform; luster low to medium; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40; air-dry density 31pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second set on 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	10,400	1,640	--
12% (2)	9,300	--	4,400

Janka side hardness at 12% moisture content 725 lb for Panama material and 530 lb for Venezuela material.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries rapidly without developing degrade due to checking or warping. No kiln schedule data available. Shrinkage green to ovendry: radial 5.1%; tangential 8.3%; volumetric 13.8%.

Working Properties: The wood is easy to work but tends to develop fuzzy grain during planing. A poor wood for turnery. Easy to cut into veneer.

Durability: The wood is very susceptible to attack by decay fungi and insects, also prone to blue stain.

Preservation: The wood is easy to treat with pressure-vacuum systems to get complete penetration and absorptions up to 20 pcf.

Uses: Boxes and crates, general carpentry and interior construction, utility furniture, millwork, veneer and plywood, particleboard.

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DIALIUM GUIANENSE

JUTAHY

Family: Leguminosae

Other Common Names: Guapaque (Mexico), Paleta (Guatemala, Honduras), Tamarindo montero (Nicaragua), Hauso (Panama), Tamarindo (Colombia), Cacho (Venezuela), Huitillo (Peru), Jataí-peba, Parajuba (Brazil).

Distribution: From southern Mexico through Central America to the Peruvian Amazon and Bahia and Matto Grosso, Brazil. In parts of its range the tree is very common on well-drained clay soils or sandy soils.

THE TREE Reaches a height of 115 ft with trunk diameters 24 to 30 in. above the narrow buttresses. Boles are cylindrical and clear to 50 ft.

THE WOOD General Characteristics: Heartwood uniform brown or reddish-brown, becoming darker upon exposure; very distinct but not sharply demarcated from the thick whitish or yellowish sapwood. Luster medium; texture fine to medium; grain straight to interlocked; without distinctive odor or taste. Silica content reported to be as high as 1.83%.

Weight: Basic specific gravity (ovendry weight/green volume) 0.81 to 0.93; air-dry density 63 to 73 pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second and third sets based on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	24,400	2,920	--
12% (3)	34,000	--	15,700
Green (1)	23,800	3,070	11,000
15%	28,800	--	13,900

Janka side hardness about 4,000 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries at a moderate to slow rate with a tendency to moderate surface and end checking, warp is reported to be slight to severe. Kiln schedule data not available. Shrinkage green to ovendry: radial 5.3%; tangential 8.9%; volumetric 13.9%.

Working Properties: The wood is rated as very difficult to work because of its high density and high silica content. Specially tipped cutters are required to effectively saw or machine this wood. Torn grain is common.

Durability: The durability of this wood is reported to be high and with high resistance to insect attack.

Preservation: The wood is rated as difficult to treat.

Uses: Heavy construction, railway crossties, industrial flooring, turnery, vehicle framing.

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1971. Properties and uses of 113 timber-yielding
species of Panama. Part 3. Physical and mechanical
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DIALYANTHERA spp.

CUANGARE
"VIROLA"

Family: Myristicaceae

Other Common Names: Fruta dorado (Costa Rica), Miguelario (Panama), Otoba (Venezuela), Cuangare (Colombia), Coco (Ecuador).

Distribution: Main commercial supply from the species growing in almost pure stands in the Pacific coastal fresh water swamp forests of Colombia and Ecuador. Other species in upland forests of Costa Rica, Panama, and Venezuela.

THE TREE May reach a height of 100 ft and a trunk diameter of 50 in.; boles are well formed and clear to 50 ft.

THE WOOD **General Characteristics:** There is no demarcation between sapwood and heartwood, pale pinkish-brown. Luster medium to high; grain generally straight; texture variable; without odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.36; air-dry density 28 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	4,020	1,010	2,080
12%	7,300	1,520	4,760
12% (2)	10,400	1,900	--

Janka side hardness 235 lb for green material and 375 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Colombian cuangare air seasons and kiln dries rapidly but material containing "brownheart" or wet streaks tends to collapse and has irregular drying rates. In kiln drying, a modified T5-C3 schedule is suggested for 4/4 stock (3). Shrinkage green to ovendry: radial 4.2%; tangential 9.4%; volumetric 12.0%.

Working Properties: Generally machines well if sharp knives are used and dressed with the grain. Easy to nail and glue; takes stain, paint, and clear finishes well.

Durability: Heartwood is nondurable and is susceptible to insect attack. Wood is prone to blue stain and requires rapid extraction and conversion.

Preservation: The wood is rated as moderately easy to preserve with uniform penetration of treating solutions.

Uses: Core stock, moldings, paneling, particleboard, general carpentry, and furniture components.

ADDITIONAL READING

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1979. Properties of seven Colombian woods. USDA Forest Serv. Res. Pap. FPL 299. Forest Prod. Lab., Madison, Wis.
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1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/FAO. Rome.
3. McMillen, J. M., and R. S. Boone.
1974. Kiln-drying selected Colombian woods. Forest Prod. J. 24(4):31-36.
4. Rice, W. W.
1966. Virola's problems unmasked. Woodworking Digest 68(8):26-30.
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DICORYNIA GUIANENSIS

BASRALOCUS
ANGÉLIQUE

Family: Leguminosae

Other Common Names: Basralokus, Barakaroeballi (Surinam),
Angélique bâtarde, Angélique gris (French Guiana).
Another species, Dicorynia paraensis, is found in the
Brazilian Amazon and is called Angelica do Pará.

Distribution: Abundant in eastern Surinam and western
French Guiana where it may make up 10% of the
forest stands. Best growth on deep, loamy, well-
drained soils of lowland plains but also found in wet
areas.

THE TREE Well-formed tree to a height of 150 ft and diameters to
5 ft but more commonly to 3 ft. Boles are clear for
60 to 80 ft over heavy buttresses.

THE WOOD General Characteristics: Heartwood reddish-brown-gray to
reddish- or yellowish-brown sharply demarcated from
narrow brownish-white sapwood. Texture medium;
unusual subsurface luster; grain usually straight,
sometimes somewhat interlocked; no distinctive odor
or taste. Vessels are prominent as long brown lines
on side grain producing an attractive figure. Silica
content reported 0.20 to 1.70% and as high as 2.92%.

Weight: Basic specific gravity (ovendry weight/green volume)
0.65; air-dry density 50pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,410	1,840	5,590
12%	17,390	2,190	8,770

Janka side hardness 1,100 lb for green material and
1,290 lb at 12% moisture content. Forest Products
Laboratory toughness average for green and air-dry
material is 151 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Moderately difficult to season, dries rapidly but with a tendency to moderate checking and slight warping. A kiln schedule similar to T2-B2 has been suggested. Shrinkage green to ovendry: radial 4.6%; tangential 8.2%; volumetric 14.0%. Reported to hold its place well after manufacture. Heartwood quite resistant to moisture absorption.

Working Properties: Working properties vary according to density and silica content but generally works well and finishes smoothly. Specially tipped cutters are suggested particularly for dried wood. Glues well.

Durability: Heartwood is resistant to very resistant to attack by decay fungi but is somewhat susceptible to dry-wood termites. The wood is resistant to attack by marine borers.

Preservation: No data available but is reported as probably extremely resistant to preservative treatment.

Uses: Marine construction and general heavy construction, railroad crossties, industrial flooring, ship decking, planking, and framing, piling, parquet blocks and strips.

ADDITIONAL READING

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1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
2. Vink, A. T.
1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.
3. Wangaard, F. F., and A. F. Muschler.
1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

DIDYMOPanax MOROTOTONI

MOROTOTO

Family: Araliaceae

Other Common Names: Yagrumo macho (Puerto Rico, Dominican Republic, Cuba, Venezuela), Chancaro blanco (Mexico), Yarumero (Colombia), Morototo, Kasavehout (Surinam), Tinajero (Venezuela), Mandioqueira (Brazil), Ambay-guazú (Argentina).

Distribution: Widespread in the wet forests of tropical America. West Indies and southern Mexico to Bolivia, Brazil, Guianas, and Argentina. Characteristic of open forests, edges of savannas, and former clearings.

THE TREE Tall basally swollen trees to height of 100 ft and more, with trunk diameters to 30 in.; cylindrical bole.

THE WOOD General Characteristics: Pale-brownish color throughout, without distinction between heartwood and sapwood. Luster medium; texture medium to rather fine; grain usually straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.36 to 0.54; air-dry density 28 to 40 pcf.

Mechanical Properties: (First set of data based on 1-in. standard; second on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	12,000	1,810	6,900
12% (2)	13,100	2,340	--

Janka side hardness reported to vary from 665 lb to 915 lb for material at 12% moisture content. Forest Products Laboratory toughness 91 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons rapidly but with considerable degrade. Warping is moderate to severe, checking and end splitting is reported to be absent to moderate. No data available on kiln schedules. Shrinkage from green to ovendry: radial 5.9%; tangential 9.2%; volumetric 14.8%.

Working Properties: The wood works easily with either hand or machine tools but has a tendency to produce fuzzy and torn grain in planing and gives only fair surfaces in most other operations. Takes screws and nails very well and is easy to glue. Can be cut into utility grade veneers.

Durability: The wood is very susceptible to fungus and insect attack as well as attack by dry-wood termites; also prone to blue stain.

Preservation: Absorption and penetration of treating solutions are only fair using either open tank or pressure-vacuum systems. However, there is good end grain penetration and so will respond to incising.

Uses: General carpentry and interior construction, utility plywood, boxes and crates, match splints, particleboard, and corestock.

ADDITIONAL READING

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3. Longwood, F. R.
1961. Puerto Rican woods: Their machining, seasoning, and related characteristics. Agriculture Handbook No. 205. U.S. Department of Agriculture.

DIPLOTROPIS PURPUREA

SUCUPIRA

Family: Leguminosae

Other Common Names: Botonallare, Peonia (Venezuela), Tatabu, Aramatta (Guyana), Zwarte kabbes (Surinam), Coeur dehors (French Guiana), Sapupira, Supupira, Sucupira (Brazil).

Distribution: Uplands of the Guianas and in Pará and Amazonas in Brazil. Fairly common in parts of Brazil and French Guiana, infrequent in Surinam and Guyana.

THE TREE Commonly 90 to 100 ft in height and 16 to 24 in. in diameter, occasionally up to 40 in. The bole is usually straight, cylindrical, unbuttressed, and clear to lengths of 60 to 70 ft.

THE WOOD General Characteristics: Freshly cut heartwood is generally chocolate-brown turning to a lighter brown when dry, occasionally grayish-brown, with fine lighter parenchyma stripes; sharply demarcated from whitish or yellowish sapwood. Texture coarse; grain usually straight to slightly interlocked or slightly wavy; luster medium to high and golden, often with a waxy appearance; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.78; air-dry density 58 pcf.

Mechanical Properties: (First set of values based on the 2-in. standard; second set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	17,400	2,680	8,020
12%	20,560	2,870	12,140
12% (1)	20,900	3,140	12,300

Janka side hardness 1,980 lb for green material and 2,140 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 201 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is moderately difficult to air season and rapid drying results in some checking and warping. Considerable checking and warping will occur in kiln drying unless a mild schedule is used; T7-B3 has been suggested for 4/4 stock. Shrinkage green to ovendry: radial 4.6%; tangential 7.0%; volumetric 11.8%.

Working Properties: The wood is moderately difficult to work and resulting surfaces, especially in planing, are fair to poor due to the coarse texture and frequent grain irregularity. The wood turns well and takes a good finish if filler is first applied.

Durability: In laboratory evaluations, the heartwood is rated very durable in resistance to both white-rot and brown-rot fungi. Other evaluations rate the wood as moderately durable; highly resistant to attack by dry-wood termites; not resistant to marine borers.

Preservation: If there is good end-grain exposure, absorption and penetration of preserving solutions are adequate using either open tank or pressure-vacuum systems.

Uses: Heavy construction work, boat building, flooring, furniture components, turnery, railroad crossties, and tool handles.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

DIPTERYX ODORATA
SYN. COUMAROUNA ODORATA

TONKA
EBO

Family: Leguminosae

Other Common Names: Almendro (Costa Rica, Panama),
Sarrapia (Venezuela, Colombia), Cumaru (Brazil),
Charapilla, Cumarut (Peru).

Distribution: The Guianas, Venezuela, Colombia, and the Amazon region of Brazil; reaches its best development on well-drained gravelly or sandy sites. Cultivated in many areas for the tonka beans used as a flavoring.

THE TREE A large overstory tree sometimes to 160 ft in height and trunk diameters to 40 in.; unbuttressed cylindrical boles are generally clear to 60 to 80 ft.

THE WOOD General Characteristics: Fresh heartwood is reddish-brown or purplish-brown with light yellowish-brown or purplish streaks; upon exposure gradually becomes uniform light brown or yellowish-brown. Sapwood is distinct, narrow, yellowish-brown. Luster rather low to medium; texture fine; grain interlocked; waxy or oily feel; taste not distinctive but may have a vanilla-like or rancid odor.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.80 to 0.91; air-dry density 62 to 81 pcf.

Mechanical Properties: (First set of values based on 2-in. standard; second set on 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	19,290	2,690	9,020
12%	27,270	3,030	13,720
12% (1)	22,400	3,010	13,200

Janka side hardness 2,200 lb for green material and 3,540 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 265 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is rated as easy to air season with a slight tendency to check and with moderate warping; drying was uniformly rapid. No dry kiln data available. Shrinkage from green to ovendry: radial 5.0%; tangential 7.6%; volumetric 12.0%.

Working Properties: The wood is difficult to saw and bore; where severely interlocked grain is not present, the wood planes to a smooth surface. Because of its high density and oily nature, the wood glues poorly.

Durability: The timbers have a reputation for being very durable. Laboratory tests also show the heartwood to be very durable in resistance to both brown-rot and white-rot fungi. The wood has excellent weathering characteristics.

Preservation: Heartwood absorption and penetration of treating solutions using both open tank and pressure vacuum systems are inadequate. Sapwood is reported to treat well, particularly with a high end grain exposure.

Uses: Heavy construction, cogs and shafts, barge and dock fenders, flooring, railroad crossties, pulpmill equipment, tool handles, bearings, turnery. A substitute for lignumvitae.

ADDITIONAL READING

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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

ENTEROLOBIUM CYCLOCARPUM

GUANACASTE

Family: Leguminosae

Other Common Names: Conocaste, Orejó, Perota (Mexico), Genicero, Jarina (Costa Rica), Corotú (Panama), Orejero, Caro (Colombia), Carocaro (Venezuela).

Distribution: Mexico and southward through Central America to Venezuela, Trinidad, Guyana, and Brazil; often planted as an ornamental.

THE TREE Tree heights 60 to 100 ft with a stout short trunk 3 to 6 ft or more in diameter; large spreading crown.

THE WOOD General Characteristics: Heartwood brown with various shadings, sometimes with a reddish tinge; sharply demarcated from the whitish sapwood. Grain typically interlocked; texture coarse; without distinctive odor or taste but dust from machining is pungent and irritating to mucous membranes and may cause allergies.

Weight: Basic specific gravity (ovendry weight/green volume) 0.34; air-dry density 26pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	8,500	1,050	4,900
Green (2)	5,030	610	--

Janka side hardness at 12% moisture content 520 lb.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons with little tendency to warp or check. Kiln schedule T6-D4 is suggested for 4/4 stock. Shrinkage green to ovendry: radial 2.0%; tangential 5.2%; volumetric 7.2%. Holds its place well when manufactured.

Working Properties: The wood is easy to work with hand and machine tools but raised and chipped grain is common in planing as well as rough end grain in shaping. Tension wood is common resulting in fuzzy grain in most operations. Dust from dry wood is an irritant.

Durability: The heartwood is reported to have good resistance to attack by decay fungi; also resistant to dry-wood termite attack.

Preservation: No data available.

Uses: Corestock, pattern wood, paneling, interior trim, furniture components, and veneer.

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1971. Resultados de estudios físico-mecánicos de algunas maderas de la Serranía de San Lucas. Plegable Divulgativo, División Forestal, INDERENA, Bogotá.
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1968. Propiedades seleccionadas de 52 especies de madera del Departamento del Petén, Guatemala. Proyecto de Evaluacion Forestal. FAO-FYDEP.
3. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.

ENTEROLOBIUM SCHOMBURGKII

TIMBAUBA

Family: Leguminosae

Other Common Names: Harino (Panama), Menudito (Venezuela), Bougou bati batra, Acadia franc (French Guiana), Angelium, Timbaúba (Brazil), Jebio, Hevio (Bolivia).

Distribution: Central America and southward to the Guianas and northern Brazil, Peru, and Bolivia; preferring noninundated sandy soil.

THE TREE Grows to a height of 120 ft with trunk diameters sometimes reaching 6 ft.

THE WOOD General Characteristics: Seasoned heartwood is light yellowish-brown sometimes with darker streaks; narrow sapwood is deep cream in color. Grain is usually straight, sometimes interlocked; texture medium; luster low to medium; without odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.82; air-dry density 62 pcf.

Mechanical Properties: (First two sets of data based on 2-in. standard; the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	16,490	2,820	7,430
12%	23,540	3,180	11,520
12% (2)	18,200	2,720	--
12% (1)	21,900	3,120	13,100

Janka side hardness 2,000 lb for green material and 2,330 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 285 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is rated difficult to air season; moderate crook and surface checking developed in wood dried at a fast to moderate rate. No dry kiln data available. Shrinkage from green to ovendry: radial 3.8%; tangential 8.8%; volumetric 13.9%.

Working Properties: The wood is rated as easy to moderately difficult to work, generating only a small amount of fuzzy grain in planing, otherwise finishing smoothly. Workmen occasionally allergic to the dust.

Durability: The wood is rated as very durable in resistance to attack by both white-rot and brown-rot fungi.

Preservation: The heartwood is very difficult to treat and the sapwood is only slightly less so.

Uses: Furniture and cabinet work, heavy construction, railroad crossties, flooring, and tool handles.

ADDITIONAL READING

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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

EPERUA SPP.

WALLABA

Family: Leguminosae

Other Common Names: Palo machete (Venezuela), Wallaba (Guyana), Walaba, Bijlhout (Surinam), Wapa (French Guiana), Apá, Apazeiro, Jébaro (Brazil).

Distribution: Centered in the Guianas but extends into Venezuela and the Amazon region of northern Brazil. Generally occurs in pure stands or as dominants, mostly on acid white sandy soils. Also common in creek valleys and in high savanna forests.

THE TREE Usually 80 to 90 ft high with trunk diameters 16 to 24 in. above the low buttresses. Boles straight, cylindrical, and clear to 40 to 60 ft. Heart rot common.

THE WOOD General Characteristics: Heartwood light to dark red to reddish- or purplish-brown with characteristic dark gummy streaks; sharply demarcated from the narrow grayish- or brownish-white sapwood, also streaked with gum. Texture rather coarse; grain typically straight; luster absent; taste not distinctive but with rancid odor when fresh which disappears on drying.

Weight: Basic specific gravity (ovendry weight/green volume) 0.78; air-dry density 58pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	15,100	2,180	8,380
12%	20,200	2,130	11,210

Janka side hardness 1,540 lb for green material and 2,040 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Wood dries very slowly with a marked tendency to check, split, and warp; honeycomb may develop in thick material. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Air drying should precede kiln drying. Shrinkage green to ovendry: radial 3.6%; tangential 6.9%; volumetric 10.0%.

Working Properties: Though the wood has a high density, it is easy to work with hand and machine tools; however, high gum exudation clogs saw teeth and cutters. Once kiln dried, gum exudates are not a serious problem in machining; glues and polishes well.

Durability: Heartwood is reported to be very durable, resistant to subterranean termites, and fairly resistant to dry-wood termites. Resistance to marine borers is low.

Preservation: Extremely resistant to preservation treatments.

Uses: Heavy construction, railroad crossties, poles (sapwood peeled), industrial flooring, tank staves, and highly favored for charcoal.

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1972. Handbook of hardwoods. H. M. Stationery Office. London.
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1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.

ESCHWEILERA SPP.

MANBARKLAK

KAKERALLI

Family: Lecythidaceae

Other Common Names: Oxito, Olleto (Panama), Coco de mono, Montanero (Venezuela), Coco cristal, Tete congo (Colombia), Haudan, Kakeralli (Guyana), Oemanbarklak, Manbarklak (Surinam), Matá-matá, Aterebá, Jarána (Brazil).

Distribution: About 80 species are distributed from eastern Brazil through the Amazon Basin to the Guianas, Trinidad, and Costa Rica.

THE TREE

Most species reach heights of 90 to 120 ft with trunk diameters of 16 to 24 in., sometimes up to 40 in. Boles are moderately well formed, 40 to 60 ft long; often somewhat fluted or slightly buttressed.

THE WOOD

General Characteristics: Heartwood of most species is light brown, grayish-brown, reddish-brown, or brownish-buff, sometimes with black streaks, usually distinct from the yellowish sapwood. Luster low; grain typically straight; texture fine and uniform; without distinctive odor or taste. Depending on species, silica content may be as high as 2.4%.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.62 to 0.95, mostly about 0.85; air-dry density ranges from 48 to 74 pcf, averaging about 64.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	10,870	1,480	3,880
12%	14,460	1,760	6,370
Green (4)	17,110	2,700	7,340
12%	26,470	3,140	11,210
12% (1)	30,300	3,180	13,400

Janka side hardness for green material ranges from 1,280 lb to 2,480 lb. Forest Products Laboratory toughness average of green and dry material ranges from 239 to 365 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is rated as fairly difficult to air season, drying rates are slow to moderate. Warp and checking are rated as slight to moderate, depending on species. No kiln schedule data available. Shrinkage from green to ovendry typically: radial 5.8%; tangential 10.3%; volumetric 15.9%.

Working Properties: Most of the species are difficult to work because of the high density and high silica content (excepting E. tenax); specially tipped cutters are suggested.

Durability: Most species are highly resistant to attack by both brown-rot and white-rot fungi. Also most of the species have gained wide recognition for their high degree of resistance to marine-borer attack. Resistance to dry-wood termite attack is variable, depending on species.

Preservation: Highly resistant to preservation treatments.

Uses: Marine and other heavy construction, industrial flooring, pulpmill equipment, railroad crossties, piling, and turnery.

ADDITIONAL READING

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EUCRYPHIA CORDIFOLIA

ULMO

Family: Eucryphiaceae

Other Common Names: Gnulgu, muermo, Roble de Chile,
Ulmo (Chile).

Distribution: Occurs in Chile between 37° and 44° S.
latitude, extending up the mountains to the edge of
glaciers.

THE TREE May reach a height of 130 ft and trunk diameters to 24 in.

THE WOOD General Characteristics: Heartwood reddish- or grayish-brown, sometimes variegated; not sharply demarcated from the lighter colored sapwood. Luster rather high; texture fine and uniform; grain generally straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.48; air-dry density 38 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	7,000	1,130	3,770
12%	11,000	1,420	6,500

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood is rather difficult to season and is prone to severe surface and end checking. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.5%; tangential 8.2%; volumetric 13.2%.

Working Properties: Reported to have good working properties.

Durability: Heartwood is nondurable.

Preservation: The wood responds well to preservation treatments with good lateral penetration. Sapwood and heartwood are equally treatable.

Uses: Railroad crossties (treated), flooring, general construction, furniture, and joinery.

ADDITIONAL READING

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1972. [Pressure treatment of Ulmo (Eucryphia cordifolia) with oily wood preservatives.] Holz als Roh-und Werkstoff 30(12):474-478.

EUXYLOPHORA PARAENSIS

PAU AMARELLO

Family: Rutaceae

Other Common Names: Amarello, Limão-rana, Pau setim,
Pequia setim (Brazil).

Distribution: Confined to noninundated lands of the lower
Amazon region in the State of Pará, Brazil.

THE TREE A large tree of the "terra firme" reaching a height of 130 ft.

THE WOOD General Characteristics: Heartwood bright clear yellow
deepening upon exposure; not sharply defined from the
yellowish-white sapwood. Luster is high; texture medium;
grain straight to irregular; without distinctive odor or
taste.

Weight: Basic specific gravity (ovendry weight/green volume)
0.70; air-dry density 54 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	13,200	2,040	6,440
12%	16,200	2,180	9,050

Janka side hardness 1,610 lb for green material and
1,820 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood is reported to be easy to season with little tendency to warp or check. No data on dry kiln schedules available. Shrinkage from green to ovendry: radial 6.0%; tangential 6.7%; volumetric 12.8%.

Working Properties: Reported not very difficult to work.

Durability: Reported probably of low resistance to decay.

Preservation: No data available.

Uses: Furniture, parquet flooring, and brush handles.

ADDITIONAL READING

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1938. Mechanical properties of certain tropical woods chiefly from South America. Univ. of Mich. School of Forestry and Conservation Bull. No. 7.
2. Record, S. J., and R. W. Hess.
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FITZROYA CUPRESSOIDES

ALERCE

Family: Cupressaceae

Other Common Names: Lahuán (Chile).

Distribution: Occurs in the central part of Chile and in the Providence of Chubut in southern Argentina.

Typically on marshy ground but also at higher elevations on Isla de Chiloé and in Patagonia; forms dense, nearly pure forests.

THE TREE On favorable sites the tree reaches heights of 130 to 150 ft and diameters of 4 ft, heights of 240 ft and diameters of 15 ft are recorded. Straight cylindrical boles often clear to 80 ft.

THE WOOD General Characteristics: Heartwood brownish-red and sharply demarcated from the narrow light-colored sapwood. Texture fine and uniform; straight-grained; growth rings usually narrow; without distinctive odor or taste; resembles California redwood.

Weight: Basic specific gravity (ovendry weight/green volume) 0.38; air-dry density 30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	6,000	940	2,690
12%	8,700	1,160	5,150

Janka side hardness 430 lb for green material and 560 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood is reported to season readily with little or no degrade. Kiln schedule data are not available. Shrinkage green to oven-dry: radial 3.8%; tangential 5.8%; volumetric 9.1%.

Working Properties: The timber works easily in all hand and machine operations; cutters must be kept sharp to get a smooth finish on end grain; easy to glue and finish. The wood is easily split to produce shakes.

Durability: Laboratory soil-block tests indicate resistance to attack by white-rot and brown-rot fungi. The wood has a local reputation for high durability.

Preservation: No data available but is reported to be probably permeable.

Uses: Shakes and shingles, general construction, pencil slats, musical instruments, vats and tanks, lumber cores, and furniture components.

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GENIPA AMERICANA

JAGUA

GENIPA

Family: Rubiaceae

Other Common Names: Jagua azul (Mexico), Irayol (Guatemala), Brir (Costa Rica), Angelina (Colombia), Caruto (Venezuela), Arasaloe, Tapoeripa (Surinam), Palo Colorado, Huitoc (Peru), Genipapeiro (Brazil).

Distribution: General distribution throughout tropical America, from the West Indies and Mexico to Argentina. Widely planted for its shade and fruit.

THE TREE Reaches a height of 70 ft; mostly 15 to 18 in. in diameter, but may reach 24 in.

THE WOOD General Characteristics: Heartwood light yellowish-brown sometimes with a slight pinkish- or purplish-blue overcast, merging gradually into the cream-colored sapwood. Luster medium; texture rather fine; grain straight to irregular; without distinctive odor or taste. Narrow bands of darker colored wood produce an attractive striped figure.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 44pcf.

Mechanical Properties: (First set of data based on 2-cm standard; second set on 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	11,000	920	4,250
15%	14,200	--	7,100
12% (2)	17,300	1,710	7,450

Janka side hardness 1,410 lb at 12% moisture content. Forest Products Laboratory toughness 184 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons slowly but with only minor warping and virtually no surface checking. Data on dry kiln schedules not available. Shrinkage from green to oven-dry: radial 4.6%; tangential 9.1%; volumetric 13.5%. Should stay in place well after manufacture.

Working Properties: Works easily and with excellent results, rates better than mahogany and teak. Glues satisfactorily and should finish without difficulty. Can be peeled to produce tight and smooth veneers.

Durability: Reported to be very susceptible to attack by dry-wood termites, pinhole borers, and decay fungi.

Preservation: Both heartwood and sapwood are reported to respond well to preservation treatments using either open tank or pressure-vacuum systems.

Uses: Shoe lasts, tool handles, bent work, furniture and cabinet work, turnery, flooring, veneer, and plywood. Fruit is used to produce a sour refreshing drink, when immature used to prepare an indelible stain.

ADDITIONAL READING

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1971. Estudo dentrológico e determinação das características físicas e mecânicas do genipapó Genipa americana L. Brazil Florestal 11(8):17-21.
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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del área del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1961. Puerto Rican woods: Their machining, seasoning, and related characteristics. Agriculture Handbook No. 205. U.S. Department of Agriculture.
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GOSSYPIOSPERMUM PRAECOX

WEST INDIAN BOXWOOD
MARACAIBO BOXWOOD

Family: Flacourtiaceae

Other Common Names: Agracejo (Cuba), Palo blanco
(Dominican Republic), Zapatero (Colombia, Venezuela).

Distribution: Dominican Republic, Cuba, the Maracaibo
Lake region of Venezuela and in eastern Colombia.
Usually on dry chalky or rocky slopes.

THE TREE A small tree yielding logs 9 to 12, sometimes 16 ft in length;
with diameters of 6 to 12, occasionally up to 18 in.

THE WOOD General Characteristics: Wood lemon-yellow to nearly white
with little or no difference between heartwood and
sapwood. Texture very fine and uniform; luster high;
grain generally straight; odor and taste not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume)
0.65 to 0.73; air-dry density 50 to 56pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: Must be converted rapidly as blue-stain is common in stored logs. Somewhat difficult to air dry; kiln drying of small dimensions is suggested; the wood has a tendency to check. Once dried has high dimensional stability. No data on shrinkage characteristics available.

Working Properties: The wood is easy to carve and turn, finishing very smoothly and taking a high natural polish.

Durability: The wood has poor resistance to attack by decay fungi and termites.

Preservation: No data available.

Uses: Precision rules, veneers for marquetry and cabinet work, engravers' blocks, jewelers' burnishing wheels, carving and turnery, handles of cutlery, piano keys, inlay, special shuttles and spindles for the textile industry.

ADDITIONAL READING

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1949. Timbers of the new world. Yale University Press. New Haven, Conn.
2. Villamil G., F. (ed.).
1971. Maderas colombianos. Proexpo, Bogotá.

GOUPIA GLABRA

KOPIE
KABUKALLI

Family: Goupiaceae
(Celastraceae)

Other Common Names: Saino, Sapino (Colombia), Kopi (Surinam), Kabukalli (Guyana), Goupie (French Guiana), Cupiúba (Brazil).

Distribution: Uplands of the lower Amazon, the Guianas, and the Serrania de San Lucas, Carare-Opon, Rio Cauca Valley, and other regions of Colombia.

THE TREE A large buttressed, semideciduous, canopy tree; grows to a height of 130 ft and with diameters to 36 in., but usually 20 to 24 in.

THE WOOD General Characteristics: Heartwood light reddish-brown, darkening superficially upon exposure; distinct but not sharply demarcated from thick brownish or pinkish sapwood. Luster medium to rather high; texture medium to coarse; grain straight to interlocked; odor is fetid when fresh but dissipates upon drying though still apparent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72; air-dry density 54 pcf.

Mechanical Properties: (First two sets of data based on 2-in. standard; third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	11,480	1,810	6,170
12%	15,300	2,150	8,350
12% (1)	16,600	2,370	10,850
Green (3)	14,000	1,980	7,350
15%	17,600	--	9,750

Janka side hardness about 1,400 lb for green material and 1,840 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 132 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Moderately difficult to air season, dries at a moderate rate with only slight warping and checking. Kiln schedule T7-B3 is suggested for 4/4 stock. Shrinkage from green to ovendry: radial 4.5%; tangential 8.0%; volumetric 12.6%.

Working Properties: It is rated fair to good in most operations but torn and chipped grain is common in planing because of interlocked grain. Coarser material requires a filler to obtain a smooth finish.

Durability: Laboratory evaluations indicate good resistance to attack by both brown- and white-rot fungi, but rated only slightly to moderately resistant to decay in field tests in Guyana. Resistant to dry-wood termite attack but has little resistance to marine borers.

Preservation: Heartwood is very resistant and sapwood is moderately resistant to preservation treatments using either open tank or pressure-vacuum systems.

Uses: Heavy construction, industrial flooring, furniture components. A highly favored general purpose timber in the Guianas.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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GUAIACUM SPP.

LIGNUMVITAE

Family: Zygophyllaceae

Other Common Names: Guayacán, Palo santo (Mexico, Central America, West Indies, Venezuela, and Colombia).

Distribution: West Indies, coastal region of tropical Mexico, west coast of Central America, and northern fringe of Colombia and adjacent areas in Venezuela. Largely confined to dry exposed sites and does well on shallow soils.

THE TREE A small tree usually 20 to 30 ft in height; often 10 to 12 in. in diameter, occasionally 18 to 30 in.

THE WOOD General Characteristics: Heartwood is dark greenish-brown to almost black and sharply demarcated from the narrow pale yellow or cream-colored sapwood. Texture very fine; grain is strongly interlocked; a slight scent is evident when warmed or rubbed. It has a characteristic oily feel due to the resin content that may be as high as one-fourth of the air-dry weight.

Weight: Basic specific gravity (ovendry weight/green volume) 1.05; air-dry density 80 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	--	--	11,400

Janka side hardness 4,500 lb at 12% moisture content. Forest Products Laboratory toughness 165 in.-lb at 9% moisture content (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood is difficult to dry and considerable care is required to avoid shakes and end splits. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. No data available on shrinkage characteristics.

Working Properties: Very difficult to work with hand or machine tools; a cutting angle of 15° or less is suggested in planing. The wood turns and shapes well and takes a high polish. Because of oily resins, requires special surface treatments for satisfactory gluing.

Durability: The heartwood is very resistant to attack by decay fungi, termites, and marine borers.

Preservation: No data available, but because of the high guaiac resin content and high density treatability should be nil.

Uses: Bearings, bushing blocks, pulley sheaves, mallet heads, and turnery. Most noted use is in bearings and bushing blocks for propeller shafts of ships because of its self-lubrication and hardness.

ADDITIONAL READING

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1959. An investigation of certain physical and mechanical properties of lignum-vitae. Forest Prod. J. 9(9):303-307.
2. Longwood, F. R.
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GUAREA SPP.

CRAMANTEE

AMERICAN MUSKWOOD

Family: Meliaceae

Other Common Names: G. trichiliooides: Guaraguao (Puerto Rico), Trompillo (Colombia, Venezuela, Bolivia), Fruta de loro (Ecuador), Cedrillo (Argentina), Gitó, Cedrohy (Brazil). G. excelsa: Cedrillo, Trompillo de plaza (Mexico), Cramantee (Belize), Guano blanco (Colombia), Cabimbo (Venezuela).

Distribution: West Indies, Mexico and Central America, and southward to southern Brazil and Argentina. Frequently planted in coffee plantations for shade.

THE TREE Varies with species but sometimes 130 ft in height and 4 ft in diameter, commonly 40 to 75 ft in height and 1 to 3 ft in diameter. Some are buttressed to 15 to 20 ft, boles straight to irregular.

THE WOOD General Characteristics: Heartwood pinkish to deep reddish-brown; sapwood distinct but not sharply demarcated from the heartwood. Luster is rather low; texture medium; grain rather straight; green wood is aromatic but odor and taste very mild or not distinctive in dry specimens.

Weight: Basic specific gravity (ovendry weight/green volume) 0.46 to 0.57; air-dry density 34 to 44 pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second on 2-cm standard; third on 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	8,000	1,340	4,070
12%	11,400	1,600	6,300
Green (<u>3</u>)	9,550	1,220	4,600
12%	12,750	1,400	6,950
12% (<u>2</u>)	17,900	--	7,750

Janka side hardness 930 lb for green material, ranges from 800 to 1,330 lb at 12% moisture content. Forest Products Laboratory toughness 140 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries slowly but with only a moderate amount of warping and no checking. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage from green to ovendry: radial 3.4%; tangential 7.0%; volumetric 11.2%. Movement after manufacture is rated as small.

Working Properties: The wood saws and machines easily and well in all operations except boring where there is a tendency to tear and crumble.

Durability: Heartwood has good resistance to dry-wood termites and is durable in the ground.

Preservation: Both heartwood and sapwood are not responsive to preservation treatments using either open tank or pressure-vacuum systems.

Uses: Furniture, cabinet work, turnery, interior trim, joinery, ship construction (planking and trim), general carpentry, and decorative and utility veneer and plywood.

ADDITIONAL READING

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HELICOSTYLIS TOMENTOSA

LECHE PERRA

Family: Moraceae

Other Common Names: Feguó, Kabákrá (Costa Rica), Berbá, Choybá (Panama), Sukune (Guyana), Basri letri, Ombatapo (Surinam), Aimpem, Inaré, Muiratinga (Brazil).

Distribution: Bahia, Brazil, through the Amazon region to northeastern Peru, Colombia, and the Guianas.

THE TREE Height to 100 ft, with straight cylindrical boles to 80 ft; trunk diameters 20 to 28 in.

THE WOOD General Characteristics: Heartwood dark brown, somewhat streaked or variegated with black and yellow; sharply demarcated from the wide, golden, lustrous sapwood. Luster medium in heartwood; texture medium; grain straight to roey; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.68 to 0.76; air-dry density 52 to 58pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)	22,800	2,860	12,300
15% (1)	27,800	--	14,100

Janka side hardness about 2,700 lb for dry material. Forest Products Laboratory toughness 260 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood dries rapidly and with only slight degrade. Data on dry kiln schedules not available. Shrinkage from green to ovendry: radial 5.4%; tangential 9.2%; volumetric 14.6%.

Working Properties: The wood is rated fair to good in all machining operations but does cause excessive dulling of cutting edges; takes a high natural polish.

Durability: The heartwood is susceptible to attack by decay fungi; sapwood is prone to blue stain.

Preservation: The heartwood is difficult to treat, as is the sapwood.

Uses: Heavy construction, flooring, turnery, and furniture.

ADDITIONAL READING

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1971. Resultados de los estudios físico-mecánicos de 41 especies maderables de la region Cararé-Opón. Plegable Divulgativo, División Forestal, INDERENA, Bogotá.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

HEVEA BRASILIENSIS (PLANTATION)

PARÁ RUBBERTREE

Family: Euphorbiaceae

Other Common Names: Árbol de caucho (Venezuela), Sibi-sibi (Guyana), Mapalapa (Surinam), Seringa, Seringuera (Brazil), Capi, Jéve, Shiringa (Peru).

Distribution: Amazon Basin, but widely planted in Southeast Asia and West Africa for rubber production.

THE TREE In the wild may reach heights of 100 to 125 ft with large cylindrical trunks with or without buttresses. Cultivated the tree reaches a diameter of about 20 in., usually with a short bole, and with pronounced taper.

THE WOOD General Characteristics: Heartwood whitish when freshly cut, becoming light brown on exposure, with a pink tinge; not distinct from sapwood. Texture moderately coarse and even; grain straight; has a characteristic sour smell; luster low.

Weight: Basic specific gravity (ovendry weight/green volume) 0.46 to 0.52; air-dry density 35 to 40 pcf.

Mechanical Properties: No data available but is reported to be equal to or stronger than *Pinus sylvestris* in all mechanical properties.

Drying and Shrinkage: Air dries rapidly; warp is severe unless stickers are closely spaced and the piles are weighted; should be dried under cover. Lumber requires chemical dipping to control blue stain and borer attack. Kiln schedule T6-D2 is suggested for 4/4 stock.
Shrinkage green to ovendry: radial 2.3%; tangential 5.1%.

Working Properties: The timber is reported to saw without difficulty and planes easily to a smooth surface; tends to split in nailing.

Durability: The timber is perishable and stains readily. Also highly susceptible to borer and termite attack as well as powder-post beetles.

Preservation: Reported to have satisfactory treatability; absorbs 7 pcf of preservative oils using a hot and cold bath system.

Uses: Can be used in general construction provided particular care is used to control stain and insect attack, pulp and paper products, fiberboard, and particleboard, furniture components.

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2. Thomas, A. V., and F. H. Landon.
1953. The timber of para rubber. The Malayan Forester 16(4):217-219.

HIBISCUS ELATUS
and H. TILIACEUS

BLUE MAHOE

Family: Malvaceae

Other Common Names: Emajagua excelsa (Puerto Rico),
Majagua, Majagua azul (Cuba), Mountain-mahoe (Jamaica).

Distribution: Reported to be native to Cuba and Jamaica
but widely planted and naturalized from southern
Florida to Mexico, Peru, and Brazil and throughout the
West Indies.

THE TREE Commonly grows to a height of 60 to 70 ft; with trunk
diameters of 12 to 18 in., on favorable sites may
attain diameters of 36 in. Boles are straight and of
fairly good length.

THE WOOD General Characteristics: Heartwood is basically a grayish-
brown or olive but often richly variegated with shades
of purple and metallic blue; distinct from the narrow
nearly white sapwood. Texture medium often variable;
grain fairly straight; luster rather dull; no distinctive
odor or taste.

Weight: Basic specific gravity (ovendry weight/green
volume) 0.62; air-dry density 47 pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: No information available, but being prized as a high-grade furniture wood suggests good seasoning characteristics.

Working Properties: The timber is reported to work easily.

Durability: The heartwood is reported to be highly resistant to attack by decay fungi.

Preservation: No information available.

Uses: Cabinet work, furniture, inlay work, interior trim, building construction, railroad crossties. Bark of young trees is used for cordage.

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HOLOPYXIDIUM JARANA

JARANA

Family: Lecythidaceae

Other Common Names: Jarána, Inhauba (Brazil).

Distribution: On fertile soils in upland forests throughout the State of Pará in Brazil; particularly abundant along the lower Tapajos River.

THE TREE Reported as a large tree, data on measurements not available.

THE WOOD General Characteristics: Fresh heartwood is light brown to blood-red in color, salmon-pink to brownish-red when dry; sapwood yellowish-cream, 2-1/2 in. wide. Texture uniformly fine; grain straight; luster low; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.76 to 0.85; air-dry density 58 to 65pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	19,690	2,390	7,670
12%	30,170	2,910	12,540
Green (1)	15,100	1,980	5,880
15%	23,600	--	11,000

Janka side hardness 2,280 lb for green material and 3,500 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 360 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries rapidly with only slight warp and surface checking; rated easy to season. No data on kiln schedules available. Shrinkage from green to ovendry: radial 6.2%; tangential 8.3%; volumetric 16.8%.

Working Properties: The wood is moderately difficult to work because of its high density but smooth surfaces are obtained in sawing, planing, and boring. No pronounced dulling of cutting edges was reported.

Durability: In laboratory tests the wood is rated very durable in resistance to brown-rot and white-rot fungi. Railroad ties are reported to last 10 to 12 years on well-drained soil in Brazil. The wood is low in resistance to marine borers.

Preservation: No information available.

Uses: Carpentry, railway crossties, heavy construction. Because of outstanding shock resistance should be suitable for handle stock and other applications requiring toughness.

ADDITIONAL READING

1. Mainieri, C.
1971. 25 madeiras da Amazônia de valor comercial, caracterização, macroscópica, usos comuns, e índices qualificativos. Publicacão, Inst. Pesqu. tec. S. Paulo No. 798.
2. Wangaard, F. F., A. Koehler, and A. F. Muschler.
1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

HUMIRIA BALSAMIFERA

TAURONIRO
UMIRI

Family: Humiriaceae

Other Common Names: Bastard bulletwood, Tabaniro (Guyana), Basra bolletrie, Tawanangro (Surinam), Bois rouge, Houmiri (French Guiana), Oloroso (Colombia), Couramira, Turanira (Brazil).

Distribution: The Guianas, Colombia, Venezuela, and the Brazilian Amazon. In Guyana it is a principal dominant species in the marsh forests; does best on light sandy soils. In Surinam occurs in savanna forests.

THE TREE Heights 90 to 120 ft with long cylindrical clear bole 60 to 70 ft; commonly 20 to 28 in. in diameter, occasionally up to 48 in.

THE WOOD General Characteristics: Heartwood varies from light brown to reddish-brown; poorly demarcated from the narrow light brown sapwood. Texture medium; grain straight to interlocked; luster medium; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.66; air-dry density 50pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,720	2,060	5,810
12%	18,770	2,510	8,950

Janka side hardness 1,320 lb for green wood and 1,610 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 146 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood air dries at a rapid rate with slight surface and end checking and some warping. No data available on kiln schedules. Shrinkage from green to ovendry: radial 7.2%; tangential 9.7%; volumetric 15.7%.

Working Properties: The wood is moderately difficult to work, considerable chipped grain develops in planing wood with interlocked grain.

Durability: The species of Humiria have a reputation of being highly durable. Pure culture tests rate the wood very durable when exposed to white-rot fungus but durable to moderately durable in resistance to a brown-rot fungus. The wood is rated resistant to dry-wood termites, but little resistance to marine borers.

Preservation: No information available.

Uses: Heavy construction, flooring, furniture, wheel spokes, suggested as a possible decorative veneer.

ADDITIONAL READING

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1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
2. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.
3. Wanggaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

HURA CREPITANS

HURA
POSSUMWOOD

Family: Euphorbiaceae

Other Common Names: Arbol del diablo, Haba (Mexico), Jabillo (Central America), Ceiba amarilla, Ceiba de leche (Colombia), Ceiba blanca, Ceiba habillo (Venezuela), Assacú, Açaçu (Brazil).

Distribution: Throughout the West Indies and from Central America to northern Brazil and Bolivia. Often occurs in nearly pure stands in Surinam on moist sandy loam. Frequently cultivated for shade.

THE TREE Commonly reaches heights of 90 to 130 ft with clear boles of 40 to 75 ft; diameters of 3 to 5 ft and at times 6 to 9 ft. Trees often have small buttresses; bark covered with conical spines.

THE WOOD General Characteristics: Heartwood pale yellowish-brown or pale olive-gray; sapwood yellowish-white often indistinct from heartwood. Texture fine to medium; luster high; grain straight to interlocked, without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.33 to 0.38; air-dry density 25 to 28 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	6,310	1,040	2,790
12%	8,710	1,170	4,800
Green (<u>3</u>)	5,100	820	2,270
15%	8,000	--	3,860
12% (<u>1</u>)	7,050	895	--

Janka side hardness 440 lb for green material and 550 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 70 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Moderately difficult to air dry; with variable warping, sometimes severe. Checking is slight. Dry kiln schedule T6-D2 is suggested for 4/4 stock and schedule T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.7%; tangential 4.5%; volumetric 7.3%. Movement in place is rated as medium.

Working Properties: The wood usually machines easily but green material is somewhat difficult to work due to tension wood, resulting in fuzzy surfaces. The wood finishes well and is easy to glue and nail.

Durability: The wood is reported to be very variable in resistance to attack by decay fungi; highly susceptible to bluestain and very susceptible to dry-wood termites.

Preservation: The wood is easy to treat, with absorption to 20pcf using an open tank process.

Uses: General carpentry, boxes and crates, veneer and plywood, joinery, furniture, fiberboard, and particleboard.

ADDITIONAL READING

1. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
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1971. 25 madeiras da amazônia de valor comercial caracterização, macroscopia, usos comuns e índices qualificativos. Publicação, Inst. Pesqu. tec. S. Paulo No. 798.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

HYERONIMA ALCHORNEOIDES
and HYERONIMA LAXIFLORA

SURADAN
PILÓN

Family: Euphorbiaceae

Other Common Names: Curtidor (Honduras), Nancito (Nicaragua), Pantano (Panama), Carne asada, Trompillo (Venezuela), Cargamanto Casaco (Colombia), Suradanni (Surinam), Sangue-de-boi, Urucurana (Brazil).

Distribution: Depending on the species, ranges from southern Mexico to southern Brazil including the Guianas, Peru, and Colombia, also throughout the West Indies. Varies from abundant in seasonal marshes to relic occurrence in old forests on heavy soils.

THE TREE	Large straight trees with spreading rounded buttresses; reaching heights of 130 ft; with trunk diameters of 3 ft or more, but more commonly with diameters of 20 to 24 in. Stems are often clear to 70 ft.
THE WOOD	General Characteristics: Heartwood is a light reddish-brown, to chocolate-brown, to dark red; sapwood is pinkish-white and 1 to 2 in. wide. Luster is low; texture moderately coarse; grain is interlocked; without distinctive odor or taste; tangential surfaces have parabolic markings due to variations in color at the margins of seasonal growth increments.

Weight: Basic specific gravity (ovendry weight/green volume) 0.60 to 0.67; air-dry density 46 to 53 pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	10,680	1,880	4,960
12%	18,200	2,270	9,620
Green (2)	11,500	1,520	4,900
15%	16,500	--	8,450

Janka side hardness 1,220 lb for green material and 1,700 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 187 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and shrinkage: The wood air seasons rapidly with only a moderate amount of warp and surface checking developing. No data on kiln drying schedules available. Shrinkage from green to oven dry: radial 5.4%; tangential 11.7%; volumetric 17.0%.

Working Properties: The wood is reported to have good working properties in all operations except planing which is rated poor due to the characteristic roey grain.

Durability: The wood is rated moderately durable to very durable in ground contact based on laboratory pure culture evaluations as well as experience in railroad track. Resistant to moderately resistant to subterranean and dry-wood termites. Resistance to marine borers reported high for H. laxiflora.

Preservation: Both heartwood and sapwood are reported to treat moderately well using both open tank and pressure-vacuum systems; test specimens had large end-grain exposure.

Uses: Heavy construction, railway crossties, marine work, furniture, cabinet work, decorative veneers, flooring, turnery, and joinery.

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paul No. 31.
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HYMENAEA COURBARIL

COURBARIL

Family: Leguminosae

Other Common Names: Cuapinol, Guapinol (Mexico), Guapinol (Central America), Locust, Kawanari (Guyana), Rode lokus (Surinam), Algarrobo (Spanish America), Jatahy, Jatobá (Brazil).

Distribution: Southern Mexico, throughout Central America and the West Indies to northern Brazil, Bolivia, and Peru. The tree's best development is on ridges or slopes and high riverbanks.

THE TREE May grow to a height of 130 ft with trunk diameters of 5 to 6 ft; usually less than 100 ft high with diameters of 2 to 4 ft. Boles are well formed, often clear for 40 to 80 ft, and basally swollen or buttressed in large trees.

THE WOOD General Characteristics: Heartwood is salmon-red to orange-brown when fresh, becoming russet to reddish-brown when seasoned; often marked with dark streaks. Sapwood is usually wide, white, gray, or pinkish. Texture is medium to rather coarse; grain mostly interlocked; golden luster; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.71 to 0.82; air-dry density 52 to 61 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	12,940	1,840	5,800
12%	19,400	2,160	9,510
12% (2)	25,800	3,120	--
12% (1)	25,100	2,870	14,200

Janka side hardness at 12% moisture content 2,350 to 3,290 lb. Forest Products Laboratory toughness average for green and dry material is 230 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is rated as slightly difficult to air dry; it seasons at a fast to moderate rate with only slight checking and warp. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.5%; tangential 8.5%; volumetric 12.7%--values are low for a wood of this density.

Working Properties: The wood is moderately difficult to saw and machine largely because of its high density, but except in planing it can be machined to a smooth surface. The wood is somewhat difficult to plane because of the interlocked grain. It is easy to glue and finish satisfactorily; steam-bending properties comparable to white oak.

Durability: Laboratory evaluations rate the wood very resistant to brown-rot and white-rot fungi; actual field exposure trials also rate the wood as very durable. Heartwood is also rated very resistant to dry-wood termites; little resistance to marine borers.

Preservation: Heartwood is not treatable using open tank or pressure-vacuum systems. Sapwood, however, is responsive.

Uses: Tool handles and other applications where good shock resistance is needed, steam-bent parts, flooring, turnery, furniture and cabinet work, railroad crossties, tree-nails, gear cogs, wheel rims, and other specialty items. Tree exudes a rosin-like gum known commercially as South American copal. Seed pods contain an edible pulp.

ADDITIONAL READING

1. FAO.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

HYMENOLOBIUM EXCELSUM

PARA-ANGELIM

Family: Leguminosae

Other Common Names: Erejoeroe, Lialiadan koleroe, Saandoe (Surinam), Angelim do Pará, Carámate, Sapupira amarella (Brazil).

Distribution: Upland forests of the central and eastern parts of the Brazilian Amazon region and extending northward into the Guianas and southward to Rio de Janeiro.

THE TREE A medium-sized to very large tree, sometimes 150 ft in height with diameters to 10 ft.

THE WOOD General Characteristics: Heartwood when fresh is light orangish tan to orange-brown turning to pale brown on exposure with a rather gradual transition to the white or grayish sapwood. Texture rather coarse and uneven; luster rather low; grain straight to interlocked; without distinctive odor or taste. Alternating zones of dark and light tissue give a figure of the Partridge wood type.

Weight: Basic specific gravity (ovendry weight/green volume) 0.63; air-dry density 47 pcf.

Mechanical Properties: (First set of data based on 2-in. standard; second set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	14,610	1,950	7,460
12%	17,610	2,050	8,990
12% (1)	13,300	2,000	9,050

Janka side hardness 1,720 lb for both dry and green material. Forest Products Laboratory toughness average for green and dry material is 203 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be moderately difficult to air season. Rate of drying fast to moderate with moderate warp and slight surface and end checking. No data on kiln schedules available. Shrinkage green to ovendry: radial 4.4%; tangential 7.1%; volumetric 10.2%.

Working Properties: The wood is easy to work in all operations and machines to a smooth surface.

Durability: In laboratory tests heartwood was rated very durable to durable upon exposure to a white-rot and durable in resistance to a brown-rot fungus. Exposure tests indicate the heartwood is only moderately resistant to marine borers.

Preservation: Heartwood and sapwood are both reported to respond well to pressure-vacuum treatments; test specimens, however, had high end-grain exposure.

Uses: Heavy construction, turnery, and furniture.

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.
3. Wangaard, F. F., A. Koehler, and A. F. Muschler.
1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

IRYANTHERA spp.

KIRIKAWA
MARA KAIPO

Family: Myristicaceae

Other Common Names: Bémoonba, Pajoelidan, Mouchigo rouge, Soewana (Guianas), Sangrito (Venezuela), Cuangare, Virola de Tumaco (Colombia), Ucuhúa-rana (Brazil).

Distribution: Upland virgin forests in the Guianas, Amazon regions of Brazil, Peru, and Colombia. Also Pacific Coastal areas of Colombia.

THE TREE Varies with species, may reach height of 130 ft and diameters to 48 in.; commonly 75 to 100 ft in height and diameters of 18 in. Boles are well formed with good merchantable lengths.

THE WOOD General Characteristics: Heartwood variable, light pinkish-cinnamon, dull oatmeal, or medium to dark brown, sometimes reddish or purplish. Sapwood wide, oatmeal-colored, often not sharply demarcated. Luster medium to fairly high; texture medium; grain mostly straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.35 to 0.57; air-dry density 26 to 44 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	7,570	1,680	3,260
12%	12,650	2,180	6,970
Green (3)	9,190	1,960	4,430
12%	15,710	2,620	9,420

Janka side hardness 580 to 710 lb for green material and 850 to 1,010 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 102 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood can be air dried with little or only moderate difficulty; slight to moderate checking and warp may develop. Data on dry kiln schedules are not available. Shrinkage from green to oven-dry: radial 5.3%; tangential 9.4%; volumetric 15.6%. These shrinkage values are unusually high when compared to other tropical woods of the same density.

Working Properties: All of the species have very good machining properties and produce smooth surfaces on the normally straight-grained material. The wood is easily peeled for veneer.

Durability: The durability of all species is rated from non-durable to only moderately durable based on pure-culture decay resistance tests. The woods are also prone to blue stain.

Preservation: No information available.

Uses: Millwork, turnery, furniture, boxes and crates, veneer and plywood, general construction, fiberboard, and particleboard.

ADDITIONAL READING

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1971. Maderas colombianas. Proexpo, Bogotá.
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1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

JACARANDA COPAIA

COPAIA

Family: Bignoniaceae

Other Common Names: Gualandai (Panama), Chingale (Colombia), Abey, Cupay (Venezuela), Goebaja (Surinam), Copaia, Faux simarouba (French Guiana), Carnauba da matta, Pará-pará (Brazil).

Distribution: From Belize southward to Brazil. A component of the upland forests of the Amazon region and also common in the mixed hardwood forests of Guyana. Regenerates abundantly on old clearings.

THE TREE May reach heights over 100 ft, with cylindrical more or less straight boles clear to 50 to 60 ft; trunk diameters usually 16 to 30 in. Trunks are unbuttressed but are basally swollen.

THE WOOD General Characteristics: Heartwood and sapwood not sharply demarcated, dull white to oatmeal color; prominent brown vessel lines. Luster rather high; texture medium to coarse; grain straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.35; air-dry density 26 pcf.

Mechanical Properties: (First two sets of data based on 2-in. standard; third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing
	Psi	1,000 psi	Psi
Green (4)*	4,580	1,160	1,980
12%	7,040	1,310	4,120
12% (2)	9,850	1,730	--
12% (1)	8,600	1,900	4,650

Janka side hardness 280 lb for green wood and 350 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 54 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood dries rapidly and is rated easy to season; only slight surface and end checking develops. No data available on kiln schedules. Shrinkage green to ovendry; radial 4.5%; tangential 6.5%.

Working Properties: The wood is easy to work; however, sawn surfaces of green lumber are often woolly. Even after seasoning, sawn and planed surfaces are apt to be fuzzy unless cutters are very sharp; easy to peel and slice into veneer.

Durability: The wood is perishable in ground contact, vulnerable to insect attack, and prone to blue stain.

Preservation: The wood has good treatability using either open tank or pressure-vacuum systems.

Uses: Furniture components, interior construction, utility plywood, boxes and crates, concrete form work, matchsticks and matchboxes, fiberboard, particleboard, and pulp and paper.

ADDITIONAL READING

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JUGLANS spp.

NOGAL

TROPICAL WALNUT

Family: Juglandaceae

Other Common Names: Nogal silvestre, Nuez meca (Mexico),
Nogal blanco, Tochte (Peru), Nogal criollo (Argentina).

Distribution: Varying with species, these walnuts range from southern Mexico, through Central America, and the Cordilleras of Colombia, Ecuador, and Peru. Also found in mountain regions of Argentina.

THE TREE Mostly up to 60 ft in height with diameters up to 36 in.; sometimes free from branches for 30 ft but more frequently clear to 10 or 15 ft.

THE WOOD General Characteristics: Heartwood chocolate-brown and generally darker than the North American black walnut, sometimes with a purplish cast; sharply demarcated from the whitish sapwood. Texture rather coarse; luster high, grain straight to irregular; odor and taste mild but distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) 0.50; air-dry density 38 pcf.

Mechanical Properties: (2-in. standard?)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
15% (4)*	9,100	1,020	5,180

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood dries very slowly, wet zones persist, and severe honeycombing and collapse may occur in stock thicker than 4/4. Air drying as thoroughly as possible before kiln drying is suggested. Kiln schedule T6-D4 is proposed for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 2.8%; tangential 5.5%.

Working Properties: The wood works well, cutting cleanly with hand and machine tools and taking an excellent finish; also peels and slices readily but the veneers are also reported to dry slowly.

Durability: No data available.

Preservation: Very low permeability is reported.

Uses: Decorative veneers, furniture, cabinet work, interior finish, and other applications similar to North American black walnut.

ADDITIONAL READING

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LECYTHIS spp.

SAPUCAIA
MONKEY POT

Family: Lecythidaceae

Other Common Names: Coco (Panama), Coco mono, Coco cristal (Colombia), Coco de mono, Olla de mono (Venezuela), Monkey Pot (Guyana), Kwattapatoe (Surinam), Castanha sapucaia, Sapucaia vermelha (Brazil), Machin-mango (Peru).

Distribution: Widely distributed from southeastern Brazil through northern South America to Costa Rica. Common in the Amazon lowlands and coastal mountain forests of Brazil.

THE TREE Size varies with species but may reach height of 130 ft with straight cylindrical boles clear to 60 ft and more, diameters of 5 to 6 ft are common; usually 20 to 30 in. Stems are somewhat buttressed or shallowly fluted.

THE WOOD General Characteristics: Heartwood light to dark salmon; sapwood creamy-yellow. Texture medium fine and uniform; luster mostly low but high in some species; grain fairly straight or slightly interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.61 to 0.93; air-dry density 46 to 69 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	18,340	2,890	8,880
12%	27,540	3,380	13,280
12% (2)	14,100	1,840	--
12% (1)	27,000	3,240	13,500

Janka side hardness for denser species 2,430 lb for green material and 3,100 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material may reach 300 to 400 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Rated as easy to moderately difficult to air season depending on species; a slow to rapid drying rate is reported. Warp and checking ranged from slight to moderate. No data on dry kiln schedules available. Shrinkage green to ovendry: radial 6.0%; tangential 7.6%; volumetric 13.4%. These values are low for a wood of this high density.

Working Properties: The wood is moderately difficult to work because of its high density; however, surfaces obtained in planing, boring, sawing, and shaping were smooth and rated as good to excellent. Silica content varies with species and dulling of cutters is also variable.

Durability: The wood is reported to be very durable upon exposure to both a white-rot and a brown-rot fungus confirming its reputation for high resistance to decay. Heartwood is also highly resistant to dry-wood termites. Reported to be moderately resistant to marine borer attack.

Preservation: The wood is highly resistant to preservation treatments.

Uses: Heavy construction, ship keels and beams, railroad crossties, industrial flooring, uses requiring high impact resistance (wagon wheels, tool handles), turnery. L. paraensis produces a highly favored edible nut.

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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

LICANIA SPP.

MARISHBALLI
KAUTA
ANAURA

Family: Chrysobalanaceae
(= Rosaceae-Chrysobalanoideae)

Other Common Names: Bois gris (Trinidad), Monkey apple (Belize), Carbonero, Sapote (Panama), Abure, Cana dulce (Colombia), Merecure de montaña (Venezuela), Kwepie, Anaura (Surinam), Pintadinho, Caraipé (Brazil), Marishballi, Kairiballi (Guyana).

Distribution: Widely distributed in tropical America but is most abundant in the Guianans and the lower Amazon region of Brazil. Frequent in the overflow woodlands of the Amazon estuary but also in upland forests.

THE TREE Varies with species: Heights range from 65 to 110 ft, well formed boles may be clear for 50 to 60 ft in the larger trees. Diameters commonly 16 to 24 in., often to 36 in. Some species are buttressed or stiltrooted.

THE WOOD General Characteristics: Heartwood is generally a yellowish-brown to brown or dark brown, sometimes with a reddish tinge; sapwood tan, often rather indistinct. Texture usually fine and close; luster rather low; usually straight grained; without characteristic odor or taste. Silica content varies with species but may be as high as 3 to 4%.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.64 to 0.91; air-dry density 52 to 72 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	17,070	2,930	7,580
12%	27,660	3,340	13,390
Green (4)	14,380	2,320	6,720
12%	20,650	2,530	11,010

Janka side hardness 2,250 lb for green material and 3,570 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 213 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The woods are rated easy to moderately difficult to air season; drying is at a moderate to rapid rate. Warping and checking are generally rated as slight. Data on kiln schedules not available. Shrinkage from green to oven-dry: radial 7.5%; tangential 11.7%; volumetric 17.2%.

Working Properties: The woods of Licania are difficult to work because of the high silica content and high density. Smooth surfaces are obtainable if tools are kept sharp. Specially hardened cutters are suggested.

Durability: Varies with species, generally considered to have low to moderately low resistance to attack by decay fungi. One species is reported to be resistant to dry-wood termite attack; all are known for their high resistance to attack by marine borers.

Preservation: Varies with species, generally heartwood is moderately responsive to both open tank and pressure-vacuum treatments. Sapwood is reported to have good absorption and penetration.

Uses: Underwater marine construction, heavy construction above ground, railroad crossties (treated), charcoal, and fuel.

ADDITIONAL READING

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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

LICARIA SPP.

KANEELHART
BROWN SILVERBALLI

Family: Lauraceae

Other Common Names: Brown silverballi, Kharemoro shiruaballi (Guyana), Kaneelhart, Kaneel-pisie (Surinam), Bois canelle (French Guiana).

Distribution: Centered mostly in the Guianas; found in association with Greenheart on hilly terrain, also in Wallaba forests on sandy soils. Occurrence is only occasional.

THE TREE May reach a height of 130 ft with diameters to 44 in., normally 90 to 110 ft with diameters of 20 to 30 in. Boles are unbuttressed but basally swollen, cylindrical, and clear for 50 to 70 ft.

THE WOOD General Characteristics: Heartwood orange or brown-yellow when freshly cut; darkening to yellowish-brown or coffee-brown on exposure and sometimes with a tinge of red or violet. Sapwood is light yellowish-brown. The wood has a fragrant odor most of which is lost on drying. Texture is fine to medium; moderately lustrous; grain straight to slightly interlocked.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.68 to 0.96; air-dry density 52 to 72pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	22,270	3,820	13,390
12%	29,860	4,060	17,400

Janka side hardness 2,210 lb for green material and 2,900 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 287 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Air seasoning characteristics are variable depending upon source and species ranging from easy to season to moderately difficult. Warp is slight but checking can be severe. No data on dry kiln schedules available. Shrinkage from green to ovendry: radial 5.4%; tangential 7.9%; volumetric 12.5%. Shrinkage is unusually low for a wood of this high density.

Working Properties: High density material is difficult to work but cuts smoothly; tends to splinter in boring. Requires care in gluing; takes an excellent finish.

Durability: Excellent resistance to both brown-rot and white-rot fungi; also rated very high resistance to dry-wood termites. There is little resistance to attack by marine borers.

Preservation: No information available.

Uses: Furniture, turnery, boat building, heavy construction, and parquet flooring.

ADDITIONAL READING

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1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.
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LONCHOCARPUS SPP.

BLACK CABBAGE-BARK
SINDJAPLÉ

Family: Leguminosae

Other Common Names: Machiche, Balché (Mexico), Chaperno (Guatemala, Costa Rica, Panama), Macaratú (Colombia), Guaimaro, Marajagua (Venezuela), Sindjaplé (Surinam), Haiari (Guyana) Imbira de sapo, Timbo (Brazil), Barbasco (Peru).

Distribution: Throughout tropical America; generally on open hillsides and rather dry plains at low or moderate elevations. In Surinam occasional to locally frequent in high forests and marsh forests on alluvial flats.

THE TREE Heights up to 100 ft with trunk diameters ranging from 16 to 40 in.; low buttressed with clear boles to 60 ft.

THE WOOD General Characteristics: Heartwood yellowish-brown to dark reddish-brown; sharply demarcated from the thick yellowish sapwood. Heartwood striped with rather fine uniform parenchyma laminations of lighter color. Texture moderately coarse; luster low to medium; grain straight to irregular or interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.62 to 0.76; air-dry density from 46 to 58 pcf.

Mechanical Properties: (First set of data based on the 1-in. standard; second and third sets based on 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	25,000	3,050	12,100
Green (2)	14,500	1,920	5,400
15%	19,400	--	7,600
Green (3)	18,600	2,240	9,500
12%	25,400	2,440	12,900

Janka side hardness up to 2,700 lb at 12% moisture content. Forest Products Laboratory toughness up to 300 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Varying with species, drying rate is rather slow to rather rapid. Reported to dry satisfactorily without excessive distortion or shrinkage if dried slowly. Kiln schedule T8-B3 is suggested for 4/4 stock and T5-B1 for 8/4 (L. castilloi). Shrinkage green to ovendry: radial 3.9%; tangential 8.2%; volumetric 13.0%. Movement is rated as medium.

Working Properties: In spite of its hardness, it is not particularly difficult to work; smooth planing, however, is difficult because of interlocked grain.

Durability: Varies considerably with species. L. castilloi reported to be very resistant to fungus and insect attack; L. hedyosmus, moderately resistant; and L. sericeus, susceptible to attack.

Preservation: Generally most species are difficult to treat using either open tank or pressure-vacuum systems.

Uses: Heavy construction, flooring, furniture components. Durable species suggested for railroad crossties.

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
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1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.

LUEHEA SPP.

ESTRIBEIRO
GUACIMO

Family: Tiliaceae

Other Common Names: Tapasquit (Guatemala), Mapola (Belize), Cuacimo (Honduras, Nicaragua, Costa Rica, Panama), Algodón de monte (Colombia), Guacimo blanco (Venezuela), Agoita cavallo (Brazil), Ibatingui, Sota caballo (Argentina).

Distribution: Varying with species from southern Mexico, through Central America, and southward to the Rio de la Plata region of Argentina.

THE TREE Size varies with species: 100 to 140 ft in height with diameters of 2 to 6 ft (L. seemannii), to 65 ft in height with diameters of 20 in. (L. divaricata). Usually with irregularly fluted trunks.

THE WOOD General Characteristics: Heartwood brown or brownish, sometimes with a pinkish tinge and more or less streaked; not clearly demarcated from the sapwood. Luster varies from low to fairly high; texture fine to medium; grain straight to finely roey; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) slight variation with species from 0.47 to 0.53; air-dry density 36 to 40 pcf.

Mechanical Properties: (First set of data based on 2-cm standard; second on the 2-in. standard; third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	10,600	1,210	4,540
15%	13,700	--	6,450
Green (1)	8,500	1,520	4,200
12%	12,900	1,930	6,180
12% (3)	11,800	--	6,350

Janka side hardness about 900 lb at 12% moisture content. Amsler toughness 280 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally the various species air dries rapidly with little or no degrade. No data available on kiln schedules. Shrinkage from green to ovendry: radial 3.4%; tangential 7.8%; volumetric 11.0%.

Working Properties: Generally reported to be easy to work, however one species is reported difficult to plane and another difficult to turn.

Durability: All species are reported to be vulnerable to attack by decay fungi and insects.

Preservation: Generally reported to be easy to treat with good penetration and absorption of preservative solutions.

Uses: Millwork, furniture components, flooring, general construction, boxes and crates, veneer and plywood, particleboard, and shoe heels.

ADDITIONAL READING

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1959. Descripcion y propiedades de algunas maderas venezolanas. Instituto Forestal Latino Americano de Investigacion y Capacitacion, Merida.

LYSILOMA SPP.

SABICÚ
T'ZALAM

Family: Leguminosae

Other Common Names: Abey, Frijolillo, Jigüe, Sabicú (Cuba), Tabernau, Tavernon (Haiti), T'zalam (Mexico).

Distribution: Chiefly a Mexican genus with extensions into Central America, southernmost parts of the United States, and the Greater Antilles.

THE TREE A spreading tree with a rather short trunk, 2 to 3 ft in diameter; sometimes free of branches for 25 ft.

THE WOOD General Characteristics: Heartwood lustrous brown with a coppery or purplish tinge, sometimes faintly striped; sharply demarcated from the thin white sapwood. Texture medium; grain straight to roey; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.63; air-dry density 48 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	9,500	1,230	--
12%	12,800	1,900	--

Janka side hardness 1,320 lb for green material and 1,400 lb at 12% moisture content. Amsler toughness 292 in.-lb for green material and 345 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to air season slowly. Kiln schedule T3-C2 was used to dry 6/4 and 4/4 stock; the boards were prone to surface and end checking. Shrinkage green to ovendry: radial 2.7%; tangential 7.2%; volumetric 9.5%.

Working Properties: Considered easy to work, finishes smoothly, and takes a high natural polish.

Durability: Heartwood is rated as highly durable.

Preservation: No information available.

Uses: General construction, furniture, wheelwright work, parquet, interior trim, bobbins and shuttles, veneer, and knife handles.

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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

MACHAERIUM SPP.

CAVIUNA

PAU FERRO

Family: Leguminosae

Other Common Names: Capote, Siete cueros (Colombia), Cascarón (Venezuela), Chiche (Ecuador), Tuseque, Morado (Bolivia), Jacarandá, Jacarandá pardo (Brazil).

Distribution: The species of this group are widely distributed throughout tropical America but are most abundant in Brazil, with commercial sources in the southeast.

THE TREE Medium-sized, rarely large trees.

THE WOOD **General Characteristics:** Heartwood brown to dark violet-brown, often streaked, rather waxy; sapwood whitish, grayish, or yellowish. Luster medium to high; texture fine to coarse; grain straight to irregular; without distinctive taste but sometimes walnut scented. Wood dust may cause dermatitis.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65 to 0.75; air-dry density 49 to 57 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)* 15%	14,200 17,000	1,580 --	5,670 8,000
Green (<u>1</u>) 15%	14,000 17,500	1,240 --	5,550 8,300

Janka side hardness for green material 1,450 to 1,780 lb. Amsler toughness 282 to 346 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: No information on drying characteristics available. Shrinkage green to ovendry: radial 2.6%; tangential 6.6%; volumetric 10.0%. These values are exceptionally low for a wood of this high density.

Working Properties: Reported to be fair to excellent.

Durability: Heartwood highly resistant to attack by decay fungi.

Preservation: No information available.

Uses: Fine furniture, decorative veneers, turnery, specialty items, and cabinet work. Generally useful for the same purposes as Brazilian rosewood (Dalbergia nigra).

ADDITIONAL READING

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1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. Sa. Paul No. 31.
2. Mainieri, C.
1970. Madeira brasileiras. São Paulo, Brazil.
Instituto Florestal.
3. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.

MAGNOLIA SPP.

MAGNOLIA

VACO

Family: Magnoliaceae

Other Common Names: Laurel sabino (Puerto Rico), Corpus, Elosúchil, Semiramis (Mexico), candelillo (Costa Rica), Vaco (Panama).

Distribution: Mexico, Central America, and the West Indies; mostly in the highlands.

THE TREE

Tree heights are 70 to 100 ft with diameters occasionally up to 5 ft or more, commonly 3 ft. Boles are straight with clear lengths of 40 ft and more; sometimes buttressed.

THE WOOD

General Characteristics: Heartwood olive-green when freshly cut becoming light yellowish-brown to greenish-brown sometimes with a purplish tinge upon exposure; purple, dark brown, or nearly black streaks are common. Sapwood wide, white to greenish when first cut, darkening somewhat on exposure. Texture fine and uniform; luster low to moderate; grain straight to interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.45 to 0.59; air-dry density 34 to 44 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 12%	8,560 14,250	1,690 1,970	3,590 7,850
12% (2)	11,500	1,450	--

Janka side hardness 860 lb for green material and 1,090 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 118 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: All species are easy to air season; the wood dries rapidly with no or slight warp and checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.6%; tangential 7.0%; volumetric 11.2%.

Working Properties: The wood saws and machines easily, however in planing there may be considerable tearing where grain is irregular. M. sororum is reported to be fair to good in steam-bending quality.

Durability: Heartwood is rated durable to highly durable with respect to deterioration by both white-rot and brown-rot fungi but vulnerable to dry-wood termite attack.

Preservation: Heartwood is resistant to moisture absorption and is probably difficult to treat.

Uses: Utility veneer and plywood, millwork, furniture and cabinet work, general interior and exterior construction, boat planking, and turnery.

ADDITIONAL READING

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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

MANILKARA BIDENTATA

BULLETWOOD

BALATA

Family: Sapotaceae

Other Common Names: Chicozapote (Mexico), Ausubo (Puerto Rico, Dominican Republic), Nispero (Panama), Beefwood (Guyana), Bolletri (Surinam), Balata rouge (French Guiana), Maçaranduba (Brazil).

Distribution: Widely distributed throughout the West Indies, Central America, and northern South America; occurs in many forest types and not exacting as to soil or topography. Locally frequent.

THE TREE Well-formed tree reaching heights of 100 to 150 ft and diameters of 2 to 4 ft, occasionally up to 6 ft or more. Boles straight and clear to 60 ft, often basally swollen.

THE WOOD **General Characteristics:** Heartwood light to dark reddish-brown, distinct but not sharply demarcated from the whitish or pale brown sapwood. Texture fine and uniform; luster low to medium; grain straight to occasionally slightly wavy or interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.85; air-dry density 66 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard; second on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	17,310	2,700	8,690
12%	27,280	3,450	11,640
12% (<u>2</u>)	29,200	3,520	13,300
12% (<u>1</u>)	32,600	--	15,200

Janka side hardness 2,230 lb for green material and 3,190 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 265 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Balata or bulletwood is generally reported to be a difficult wood to air season, tending to develop severe checking and warp. However, if piled to assure a slow rate of drying, degrade can be kept to a minimum. A kiln schedule similar to Tl-B1 has been suggested. Shrinkage green to ovendry: radial 6.3%; tangential 9.4%; volumetric 16.9%.

Working Properties: The wood is moderately easy to work despite its high density, rated good to excellent in all operations. Gluing requires special care to acquire a good bond. Steam bending properties are rated excellent.

Durability: Very resistant to attack by decay fungi; highly resistant to subterranean termites and moderately resistant to dry-wood termites. Not resistant to marine borer attack.

Preservation: Has high resistance to absorption of moisture and is also highly resistant to preservation treatments.

Uses: Heavy construction, textile and pulpmill equipment, furniture parts, turnery, tool handles, flooring, boat frames and other bent work, railway crossties, violin bows, billiard cues and other specialty uses. Also well known for its yield of balata or gutta-percha collected from tapped trees.

ADDITIONAL READING

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1971. Resultados de los estudios fisico-mecanicos de 41 especies maderables de la region Carare-Opon. Plegable Divulgativo, División Forestal INDERENA, Bogotá.
2. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

MAYTENUS SPP.

CARNE D'ANTA

Family: Celastraceae

Other Common Names: Aguabola, Limncillo (Mexico), Arizá, Camarón (Colombia), Cucharo (Venezuela), Carne d'anta, Apiranga, Chuchasca, Pau de colher (Brazil), Maitén, Naranjillo (Argentina).

Distribution: Well distributed throughout tropical America, occurs scattered in the coastal forests of the Bahia region of Brazil; also well known in the Patagonian forests of Rio Negro, Argentina.

THE TREE Attains a height of 75 to 100 ft with a cylindrical bole 2 to 5 ft in diameter; with little taper and without buttresses.

THE WOOD General Characteristics: Heartwood light reddish-brown; sapwood whitish. Texture very fine and uniform; luster low to medium; grain interlocked to irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.64 to 0.77; air-dry density 49 to 59 pcf.

Mechanical Properties: (1-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	18,200	2,410	11,100

Janka side hardness 2,240 lb at 12% moisture content. Forest Products Laboratory toughness 120 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to air dry slowly with a tendency towards severe warping. No data on dry kiln schedules available. Shrinkage from green to ovendry: radial 4.6%; tangential 8.9%.

Working Properties: Reported to have satisfactory working qualities, particularly suited for turnery.

Durability: Susceptible to attack by decay fungi.

Preservation: Heartwood is reported to have excellent absorption and penetration of preservatives when treated using either an open tank or pressure-vacuum system.

Uses: General carpentry and construction, turnery, furniture, and cabinet work.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

MICROPHOLIS SPP.

GRUMIXAVA
RIEMHOUT

Family: Sapotaceae

Other Common Names: Caimitillo (Puerto Rico), Chupón colorado, Hácano (Venezuela), Moraballi (Guyana), Riemhout, Koesiri balatarie (Surinam), Faux balata (French Guiana), Grumixava, Apixuna (Brazil), Barilla de agua (Peru), Ibirá-camby (Argentina).

Distribution: West Indies and tropical America but mainly in the Guianas and Amazonia. In Surinam found in high, marsh, and savanna forests.

THE TREE May reach heights of 100 to 120 ft or more with diameters of 36 to 40 in. above the moderately high buttresses; lengths of clear boles may reach 40 to 70 ft.

THE WOOD General Characteristics: Heartwood yellow- to gray-brown with a somewhat pinkish tinge and sometimes with a yellowish-green hue; not clearly differentiated from the lighter colored sapwood. Texture fine to medium, uniform; grain mostly straight; luster medium; without distinctive odor or taste. Silica content of 0.2 to 0.5% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.54 to 0.68; air-dry density 41 to 51 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)* 12%	13,630 18,890	2,470 2,950	6,610 9,820
15% (<u>2</u>)	19,620	2,410	9,800
Green (<u>1</u>) 15%	11,000 14,500	1,500 --	4,850 7,100

Janka side hardness 1,130 lb for green material and 1,490 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 128 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries at a rapid rate with moderate warping and slight to moderate checking. No data available on dry kiln schedules. Shrinkage green to ovendry: radial 5.8%; tangential 8.5%; volumetric 14.3%.

Working Properties: Some species moderately difficult to saw and machine with rather rapid dulling of cutters due to silica. However, straight-grained stock yields smooth surfaces in most operations.

Durability: The heartwood is rated as moderately durable in resistance to white-rot fungi and very durable in resisting brown-rot fungi. Actual field experience rates this wood as moderately resistant to decay. The wood is susceptible to dry-wood termites. Resistance to marine borers is variable.

Preservation: The sapwood is reported to have moderate treatability.

Uses: Furniture components, general construction, decorative veneer, turnery, flooring, millwork, interior trim. Some resemblance to hard maple and yellow birch.

ADDITIONAL READING

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MORA EXCELSA
and MORA GONGGRIJPII

MORA

Family: Leguminosae

Other Common Names: Nato, Nato rojo (Colombia), Mora de Guayana (Venezuela), Morabukea, Mora (Guyana), Mora, Moraboekaa (Surinam), Pracuúba (Brazil).

Distribution: M. excelsa: Widely distributed in the Guianas and less so in the Orinoco Delta of Venezuela; dominant on river levees and flood plains forming dense stands. M. gonggrijpii: Restricted to Guyana and Surinam, a dominant species best adapted to hillsides on heavy clay soils.

THE TREE Usually 100 to 120 ft high and 2 to 3 ft in diameter with clear boles 60 ft and more above very large buttresses that may extend 15 ft up the trunk. Trees of M. excelsa 160 to 200 ft high and 4 ft in diameter are reported.

THE WOOD General Characteristics: Heartwood yellowish red-brown, reddish-brown or dark red with paler streaks; sapwood 2 to 6 in. wide, distinct, yellowish to pale brown. Texture moderately fine to rather coarse, rather harsh to the feel; luster medium to high; grain is straight to commonly interlocked, very variable; astringent taste and a slightly sour odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.76-0.84; air-dry density 59 to 65pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard, the second on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	12,630	2,330	6,400
12%	22,100	2,960	11,840
Green (2)	13,600	2,150	7,150
12%	24,400	2,790	12,700
15% (1)	22,320	2,615	11,160

Janka side hardness 1,450 lb for green material and 2,300 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 228 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Drying reports are variable, generally rated moderately difficult to season; a slow rate of drying and careful stacking are suggested to keep warp and other degrade to a minimum. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage from green to oven-dry: radial 6.9%; tangential 9.8%; volumetric 18.8%.

Working Properties: The wood is moderately difficult to work but yields smooth surfaces in sawing, planing, turning, or boring unless interlocked grain is present, then there may be considerable "pick up" and chipped grain. Boxed heart pieces tend to split.

Durability: Results are variable; material from Surinam and Guyana is rated durable to very durable in resistance to brown-rot and white-rot fungi. Service life of 15 to 20 years in ground contact is reported. M. gonggrijpii is rated very resistant to dry-wood termites; M. excelsa considerably less so, not resistant to marine borers.

Preservation: Sapwood responds readily to preservative treatments; heartwood resists impregnation, penetration is very shallow, and absorptions are low.

Uses: Industrial flooring, railroad crossties, shipbuilding, heavy construction, high quality charcoal wood.

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MYROXYLON BALSAMUM

BALSAMO

Family: Leguminosae

Other Common Names: Bálsmo, Palo de bálsamo (Spanish America generally), Cedro chino, Nabal (Mexico), Chirraca, Sándalo (Costa Rica), Tache, Tolú (Colombia), Estorake (Peru), Cabriúva vermelha (Brazil), Incienso, Quina (Argentina).

Distribution: Has a wide range from southern Mexico southward through Central America and continuing to Argentina.

THE TREE Up to 100 ft in height, usually 50 to 65 ft and 18 to 36 in. in diameter.

THE WOOD **General Characteristics:** Heartwood reddish-brown becoming deep red or somewhat purplish upon exposure; fairly uniform to striped; sharply demarcated from the white sapwood. Luster medium to high; texture medium; grain is typically interlocked; without distinctive taste, but may have a pleasant spicy scent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.74 to 0.81; air-dry density 54 to 62 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; the second and third on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 15%	16,900 19,200	1,820 --	8,600 10,300
12% (<u>1</u>)	25,400	--	13,400
Green (<u>3</u>) 12%	17,270 20,130	2,130 2,430	8,200 11,100

Janka side hardness 2,070 lb for green material and 2,200 lb at 12% moisture content. Amsler toughness 360 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: No information available on seasoning characteristics. Shrinkage from green to oven dry: radial 3.8%; tangential 6.2%; volumetric 10.0%. These values are very low for a wood of this high density.

Working Properties: It is reported to be moderately difficult to work but can be finished smoothly with a high natural polish. Though nonsiliceous, there is more than the usual dulling of cutters.

Durability: The heartwood is reported to be highly resistant to attack by decay fungi.

Preservation: Both sapwood and heartwood are highly resistant to preservative treatments.

Uses: Flooring, furniture, interior trim, turnery, railroad crossties. The tree is well known for its yield of balsam used in perfumes, harvested mainly in El Salvador.

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New Haven, Conn.

NECTANDRA SPP.

CANELO

LAUREL

Family: Lauraceae

Other Common Names: Aguacatillo (Mexico, Honduras, Costa Rica), Laurel (Colombia, Venezuela), Silverballi (Guyana), Pisi (Surinam), Canela (Brazil), Ayui-y, Laurel (Argentina). A large number of species make up this group.

Distribution: Widely distributed throughout tropical America.

THE TREE Varies with species, may reach a height of 100 ft; commonly up to 28 in. in diameter, occasionally to 40 in. Boles are straight and cylindrical, sometimes buttressed.

THE WOOD **General Characteristics:** Heartwood brownish-yellow with a green cast or olive to light olive-brown and in some species becoming blackish-brown; transition to whitish or brownish sapwood often gradual. Texture mostly medium to rather coarse; luster usually satiny or silky; grain straight to roey; odor spicy, taste mild to pronounced.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species, mostly 0.43 to 0.61; air-dry density 32 to 46 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second and third sets based on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)* 12%	10,440 14,230	1,540 1,650	5,020 7,260
Green (<u>1</u>) 15%	12,800 17,100	1,900 --	5,330 8,500
Green (<u>1</u>) 15%	10,900 12,400	1,370 --	4,870 6,620

Janka side hardness 930 lb for green material and 1,060 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 123 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries at a fast to moderate rate with little or no degrade due to warping or checking. No information available on dry kiln schedules. Shrinkage green to ovendry: radial 3.4%; tangential 6.0%; volumetric 9.8%.

Working Properties: The wood has excellent working properties with either machine or hand tools, dresses to a smooth finish. Glues and paints well.

Durability: May vary with species, generally rated durable in resistance to attack by decay fungi but rather susceptible to attack by dry-wood termites.

Preservation: Heartwood is extremely resistant to moisture absorption, comparable to teak and is thus difficult to impregnate.

Uses: Furniture and cabinet work, ship decking and boat planking, flooring, millwork, veneers and plywood, and general carpentry.

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NOTHOFAGUS spp.

RAULI (N. PROCERA)
COIGUE (N. DOMBEYI)

Family: Fagaceae

Other Common Names: Anis, Coihue, Coyan, Hualo, Raulí, Roble Ruilí (Chile), Coihué, Lengue, Niré, Roble (Argentina).

Distribution: Coigue: From 38° S. latitude northward along the Chilean coast and up the river valleys into the high cordilleras in northern Llanquihue on poor soils. Rauli: From the Province of Valparaiso to the Province of Valdivia, mostly on good soils.

THE TREE May reach heights of 130 ft with trunk diameters usually 2 to 3 ft, occasionally 6 to 8 ft. Boles often clear to 60 ft.

THE WOOD **General Characteristics:** Heartwood varies from pale pinkish-brown to reddish-brown to bright cherry-red; sapwood often wide, light brown. Texture mostly fine and uniform. Rauli has a tendency to ring porosity; without distinctive odor or taste; grain is straight; luster low to medium.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.45 to 0.53; air-dry density 34 to 40 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)* 12%	7,500 11,500	1,220 1,490	3,550 6,650
Green (1) 12%	10,700 17,400	1,380 1,830	4,000 8,800
Green (2) 12%	8,100 11,200	1,170 1,420	3,980 6,480

Janka side hardness 840 lb for green material, 990 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Generally very difficult to dry with a pronounced tendency to distort and collapse. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4 (Coigue). Dries rather slowly but well with little degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Movement probably small (Rauli). Shrinkage green to ovendry: radial 3.5%; tangential 7.0% (Rauli).

Working Properties: Both species are easy to work and dress cleanly; fair to good steam-bending qualities; easy to glue and finish.

Durability: Heartwood durability variable. Soil-block tests of Coigue indicate low resistance to attack by decay fungi, but some references give a provisional durable to moderately durable rating.

Preservation: Sapwood is reported to be permeable and heartwood rated as moderately resistant. Pressure-vacuum treatment of Coigue gave salt penetrations of about 3 to 24 mm.

Uses: Furniture components, cabinet work, flooring, millwork, cooperage, an all purpose timber in Chile. Rauli is the preferred species.

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OCHROMA PYRAMIDALE
SYN. O. LAGOPUS

BALSA

Family: Bombacaceae

Other Common Names: Balsa (Central and South America in general), Corcho (Mexico), Gatillo (Nicaragua), Enea, Pung (Costa Rica), Lana (Panama), Pau de balsa (Brazil), Palo de balsa (Peru), Tami (Bolivia).

Distribution: Widely distributed in tropical America; throughout the West Indies, and from southern Mexico, through Central America and into Venezuela, Colombia, Brazil, Ecuador, Peru, and Bolivia. Usually found at lower elevations especially on bottom-land soils along streams; also in clearings and cutover forests. Cultivated in plantations.

THE TREE Native trees are 60 to 90 ft high and 2.5 to 4 ft in diameter. On the best sites may reach a height of 80 ft and a diameter of 2.5 ft in 5 years. Slight buttresses develop in the larger trees.

THE WOOD **General Characteristics:** Heartwood pale brown or reddish; sapwood (comprising most of the commercial timber) nearly white or oatmeal colored often with a yellowish or pinkish hue. Texture medium to coarse; grain generally straight; luster mostly rather high; velvety feel; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies greatly, commercial balsa usually between 0.10 to 0.17. Air-dry density about 8 to 14 pcf, averaging in the trade 10 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second and third sets on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (<u>1</u>)*	3,300	460	2,250
12% (<u>4</u>)	2,120	425	1,300
12% (<u>3</u>)	2,800	550	1,700

Janka side hardness 75 to 100 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Kiln drying of converted stock preferable to air drying to minimize splitting and warping. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry for 17 pcf air-dry material grown in Puerto Rico: radial 3.0%; tangential 7.6%; volumetric 10.8%. Movement is reported to be small.

Working Properties: The wood is very easy to work with sharp, thin-edged power or hand tools. Dull or thick-edged cutters tend to give a woolly finish in planing. The wood is too soft to hold nails and screws but glues satisfactorily.

Durability: The wood is perishable; vulnerable to dry-wood termite attack; logs and green lumber are readily attacked by pinhole borers. Prone to blue stain if not converted rapidly.

Preservation: Heartwood is resistant to preservative treatments; sapwood is permeable.

Uses: Insulation for heat, vibration, and sound, rafts, lifebelts, floats, core stock in sandwich constructions, surgical splints, toys, and model airplanes.

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OCOTEA RODIAEI

DEMERARA GREENHEART

Family: Lauraceae

Other Common Names: Bibiru, Sipiri, Kevatuk (Guyana), Beeberoë, Demerara groenhart, Sipiroe (Surinam).

Distribution: Commercial quantities mostly in the north central portion of Guyana but also found in Surinam and in the Venezuelan Guiana. It has also been reported from the Maroni Region of western French Guiana and from northern Brazil.

THE TREE Grows to a height of 130 ft with diameters up to 40 in., commonly 16 to 24 in. in diameter with heights of 100 ft. Boles are cylindrical, straight, and clear for 50 to 75 ft with only moderate taper; usually basally swollen or with low buttresses.

THE WOOD **General Characteristics:** Heartwood varies from light to dark olive-green or blackish, often with intermingling of lighter and darker areas; not sharply defined from the pale yellow or greenish sapwood. Texture fine and uniform; grain straight to roey; lustrous; odorless and tasteless when dry.

Weight: Basic specific gravity (ovendry weight/green volume) 0.80 to 0.91; air-dry density 62 to 70 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	20,300	2,310	9,770
12%	26,200	3,040	13,040
Green (2)	20,900	3,040	10,690
12%	25,500	3,700	13,040

Janka side hardness 1,880 lb for green material and 2,360 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood dries very slowly with a marked tendency to check and end split; however, warping is not serious and the total amount of degrade is not excessive. Lumber over 1 in. in thickness should be air seasoned prior to kiln drying. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 8.8%; tangential 9.6%; volumetric 17.1%. Movement in service is rated medium.

Working Properties: Moderately difficult to work with hand or machine tools because of its density, dulls cutting edges rather quickly but finishes to a fine smooth lustrous surface. Turns easily and takes a high polish. A moderately good steam-bending wood. Gluing gives variable results.

Durability: The heartwood is rated highly resistant to attack by decay fungi and is also rated as highly resistant to attack by marine borers but this may vary from one locality to another, particularly in brackish waters. Highly resistant to attack by dry-wood termites.

Preservation: Impermeable to preservative treatments.

Uses: Marine and ship construction, lock gates, docks, industrial flooring, vats, filter press plates, piling, heavy construction, turnery, specialty items (fishing rods, billiard cue butts).

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Department of Agriculture.

OCOTEA RUBRA

DETERMA
RED LOURO

Family: Lauraceae

Other Common Names: Determa (Guyana), Wana, Wane (Surinam), Grignon rouge (French Guiana), Louro vermelho (Brazil).

Distribution: The Guianas, Trinidad, and the lower Amazon region of Brazil. Occasional to frequent on sandy or loamy soils in Guyana.

THE TREE Trees reach heights of 130 ft with diameters to 5 ft; usually 90 to 100 ft high with diameters of 2 to 3 ft; boles are generally basally swollen and clear 40 to 80 ft.

THE WOOD General Characteristics: Heartwood light reddish-brown with a golden sheen; well defined sapwood, narrow, dull gray or pale yellowish-brown. Texture rather coarse; grain is interlocked to straight; quartersawed lumber is sometimes attractively figured; dry wood is without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52 to 0.59; air-dry density 40 to 45 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set is based on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)* 12%	7,820 10,470	1,460 1,820	3,760 5,800
Green (<u>2</u>) 15%	10,300 13,600	1,450 --	5,150 7,150

Janka side hardness 520 lb for green material and 660 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 75 in.-lb (5/8-in. specimen). Amsler toughness 137 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is moderately difficult to air season; drying at a moderate rate with slight checking and moderate warp. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4; there is a tendency to warp and check in the kiln. Shrinkage green to ovendry: radial 3.7%; tangential 7.6%; volumetric 10.4%.

Working Properties: Works readily with hand and machine tools with little dulling effect; reported to glue readily and polishes fairly well.

Durability: Heartwood is rated durable to very durable in resistance to attack by white-rot and durable to a brown rot; moderately resistant to dry-wood termites; and is similar to teak in resistance to marine borers. Weathering characteristics are excellent and the wood is highly resistant to moisture absorption.

Preservation: The heartwood is not treatable.

Uses: Furniture, general construction, boat planking, tanks and cooperage, joinery, heavy marine construction, turnery, parquet flooring, veneer and plywood is also suggested.

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ORMOSIA spp.

BARACARA
KOKRIKI

Family: Leguminosae

Other Common Names: Palo de matos (Puerto Rico), Amargo blanco (Panama), Chocho (Colombia), Peonio (Venezuela), Mekoe (Surinam), Tento, Jatobáhy do igapó (Brazil).

Distribution: Most of the species are Amazonian but with extensions southward to São Paulo and northward to the West Indies, Central America, and southern Mexico.

THE TREE Varying with species, tree heights may reach 100 ft with diameters of 16 to 28 in.

THE WOOD **General Characteristics:** Heartwood pinkish to reddish, mostly salmon-colored, sometimes yellowish-brown, more or less streaked; not always distinct from the yellowish sapwood. Texture coarse to very coarse; luster usually medium; grain mostly irregular; feels harsh; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.50 to 0.68; air-dry density 37 to 52 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	13,510	2,060	6,520
12%	17,860	2,340	9,780
15% (<u>2</u>)	13,800	1,720	6,830
12% (<u>1</u>)	14,200	2,230	8,050

Janka side hardness 1,000 lb to 1,570 lb for dry material. Forest Products Laboratory toughness average for green and dry material is 151 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally the wood air dries very slowly.

Checking and warp vary from slight to moderate. No information available on kiln schedules. Shrinkage from green to ovendry: radial 3.6%; tangential 7.4%; volumetric 12.0%.

Working Properties: For most species, reported to saw and machine easily with fair to good results; surfaces, however, are somewhat rough and difficult to finish.

Durability: Generally reported to be quite susceptible to attack by decay fungi; vulnerable to dry-wood termites; and prone to powder-post beetle attack (sapwood).

Preservation: The heartwood and sapwood respond moderately well to pressure-vacuum preservative treatments; incising should be used where end grain exposure is low.

Uses: Furniture components, interior construction, general carpentry, and utility veneer.

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1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

OXANDRA LANCEOLATA

WEST INDIAN LANCEWOOD

Family: Annonaceae

Other Common Names: Haya prieta (Puerto Rico), Yaya (Panama, Cuba, Dominican Republic), Bois de lance (Haiti).

Distribution: Cuba, Jamaica, Hispaniola, and Puerto Rico.
Other species mostly in the Amazon basin.

THE TREE Slender forest trees up to 50 ft in height; but marketed as Lancewood spars about 13 ft long and rarely over 5 in. in diameter at the small end; all sapwood.

THE WOOD **General Characteristics:** Commercially desirable sapwood is pale yellow. Texture fine; straight-grained; luster medium; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.81; air-dry density 62 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	23,700	2,900	--

Janka side hardness 2,830 lb at 12% moisture content (values are for Oxandra sp. grown in Panama and with a basic specific gravity of 0.75).

*See "Additional Reading" for reference.

Drying and Shrinkage: Oxandra sp. of Panama is rated moderately difficult to air dry with slight checking. No dry kiln schedule information available. Shrinkage green to ovendry: radial 6.2%; tangential 9.6%; volumetric 15.4%.

Working Properties: The wood is moderately difficult to work because of its high density but finishes smoothly. Excellent turnery.

Durability: The woods are nondurable.

Preservation: No information available.

Uses: Fishing rods, billiard cues, archery bows, articles of turnery, textile machinery, and small tool handles.

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PARATECOMA PEROBA

WHITE PEROBA
PEROBA DE CAMPOS

Family: Bignoniaceae

Other Common Names: Ipê peroba, Peroba, Peroba branca, Peroba manchada (Brazil).

Distribution: Coastal forests of eastern Brazil ranging from Bahia to Rio de Janeiro.

THE TREE The tree attains a height of about 130 ft and diameters to 60 in.; boles are symmetrical and clear to 90 ft.

THE WOOD General Characteristics: Heartwood light olive, with a yellowish, greenish, or reddish hue, sometimes indistinctly striped; sharply demarcated from the white or yellowish sapwood. Texture is fine; fairly lustrous; grain commonly interlocked with a narrow stripe or roey figure; without distinctive odor or taste. Fine dust produced in machining causes skin irritations in some workers.

Weight: Basic specific gravity (ovendry weight/green volume) 0.60; air-dry density 46pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	14,100	1,490	6,500
15%	16,900	--	7,800
12% (<u>3</u>)	16,200	1,650	9,260

Janka side hardness 1,600 lb at 12% moisture content: Amsler toughness 327 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to dry readily with negligible splitting. Warp not generally serious though it may become severe in thin stock with irregular grain. Kiln schedule T3-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to oven-dry: radial 3.8%; tangential 6.6%; volumetric 10.5%.

Working Properties: The wood is reported to machine easily but care is needed in planing quartered surfaces. Easy to glue and finish. As noted, may cause dermatitis in some workers.

Durability: The heartwood is rated very durable in resistance to attack by decay fungi.

Preservation: Resistant to preservative treatments.

Uses: Fine furniture, interior joinery, decking and flooring, vats and tanks for foodstuffs, decorative veneers.

ADDITIONAL READING

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3. Lavers, G. M.
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Res. Bull. No. 50. H. M. Stationery Office. London.
4. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University
Press. New Haven, Conn.

PARINARI SPP.

BURADA
FOENGOE

Family: Chrysobalanaceae

Other Common Names: Perefuetano (Colombia), Tostado (Venezuela), Airomoradan, Burada (Guyana), Foengoe, Vonkhout (Surinam), Parinari, Pajurá (Brazil), Uchpa-umari (Peru).

Distribution: The Guianas and the lower Amazon region of Brazil, but also in other areas of northern South America.

THE TREE May attain a height of 130 ft and a diameter of 48 in., usually up to 75 ft in height with diameters to 30 in. Boles may be up to 60 to 80 ft in length; commonly buttressed for a height of about 15 ft.

THE WOOD General Characteristics: Heartwood gray-brown, yellow-brown, or yellowish pink-brown; when freshly cut often a deep orange-brown. Sapwood somewhat lighter colored and not clearly defined. Grain generally straight, sometimes interlocked; scattered pores coarse, otherwise texture is fine; luster mostly low; without distinctive odor or taste. Silica content up to about 2.0% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species 0.64 to 0.72; air-dry density 50 to 55 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	12,750 20,120	2,120 2,610	5,800 10,260
Green (<u>3</u>) 12%	14,760 21,740	2,660 2,930	6,780 11,960
12% (<u>1</u>)	19,600	2,480	9,850

Janka side hardness 1,270 lb for green wood and 1,830 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 157 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries rapidly with only slight checking; warp is moderate. Kiln schedule T2-C2 for 4/4 stock is suggested, but only after prior air drying. Shrinkage green to oven-dry: radial 5.9%; tangential 10.0%; volumetric 14.6%.

Working Properties: Because of high silica content and high density the woods are difficult to machine; cutters are dulled rapidly. However, smooth surfaces are obtained in all operations with proper maintenance of tools.

Durability: Laboratory pure culture evaluations generally show moderate durability in resistance to white-rot and brown-rot fungi. Field exposure tests, however, indicate high susceptibility to decay. Resistant to attack by marine borers.

Preservation: Reported to be treatable using a pressure-vacuum system, with good penetration and absorption of preservatives.

Uses: Marine construction; especially when continuously submerged to avoid decay fungi, ship keels, railroad crossties (treated).

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PELTOGYNE spp.

PURPLEHEART
AMARANTH

Family: Leguminosae

Other Common Names: Palo morado (Mexico), Morado (Panama, Venezuela). Tananeo (Colombia). Koroboreli (Guyana). Purperhart (Surinam). Amarante (French Guiana). Pau roxo, Guarabú (Brazil). Violetwood (English trade).

Distribution: Center of distribution in the north-middle part of the Brazilian Amazon region; combined range of all species from Mexico through Central America and southward to southern Brazil.

THE TREE Trees grow to heights of 170 ft with diameters to 4 ft, but usually 1-1/2 to 3 ft; boles are straight, cylindrical, and clear 60 to 90 ft above buttresses up to 12 ft high.

THE WOOD **General Characteristics:** Heartwood brown when freshly cut becoming deep purple upon exposure, eventually turning to a dark brown sharply demarcated from the off-white sapwood. Texture medium to fine; luster medium to high, variable; grain usually straight, sometimes wavy, roey, or irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.67 to 0.91; air-dry density 50 to 66 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second on the 2-cm standard; third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	<u>Psi</u>	<u>1,000 psi</u>	<u>Psi</u>
Green (<u>4</u>)* 12%	13,690 19,220	2,000 2,270	7,020 10,320
Green (<u>2</u>) 15%	21,000 26,700	2,560 --	9,250 12,200
12% (<u>1</u>)	30,900	3,460	14,500

Janka side hardness ranges from 1,860 lb to 3,920 lb at 12% moisture content. Forest Products Laboratory toughness at 12% moisture content ranges from 157 to 398 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reports vary, from air dries easily to moderately difficult; dries slowly to fairly rapidly; with little degrade to some warping and splitting. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: 3.2% radial; 6.1% tangential; 9.9% volumetric. Stability after manufacture or movement is rated as small.

Working Properties: Moderately difficult to work with either hand or machine tools, dulls cutters, exudes a gummy resin when heated by dull tools; slow feed rates, and specially hardened cutters are suggested. Turns smoothly, easy to glue, and takes finishes well.

Durability: Heartwood is rated as highly durable in resistance to attack by decay fungi; very resistant to dry-wood termites; but little resistance to marine borers.

Preservation: Heartwood is reported to be extremely resistant to impregnation with preservative oils; sapwood is permeable.

Uses: Turnery, marquetry, cabinets, fine furniture, parquet flooring, tool handles, heavy construction, shipbuilding, many specialty items (billard cue butts, chemical vats, carving).

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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PERSEA SPP.

LINGUE
CANELA-ROSA

Family: Lauraceae

Other Common Names: Pèche marron (Haiti), Aquacote cimarròn (Mexico), Aquacatillo (Honduras, Costa Rica), Aquacate chico (Panama), Aquacate de anís (Colombia), Palto-jeia (Peru), Lingue (Chile), Canela-rosa, Canela ruiva (Brazil).

Distribution: Throughout tropical America from the West Indies and southern Mexico southward to Chile. *P. americana* (Avocado) widely planted for its fruit. *P. lingue* (Lingue) from Coquimbo to Valparaiso and Santiago in Chile.

THE TREE Generally up to 60 to 65 ft in height with trunk diameters to 40 in.

THE WOOD General Characteristics: Heartwood brown, reddish, or pinkish; the darkest sharply demarcated from the gray or cream-colored sapwood. Texture medium to coarse; luster medium to high; grain straight to irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.39 to 0.54; air-dry density 30 to 41pcf.

Mechanical Properties: (First two sets of data based on the 2-cm standard; third on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	9,750	1,360	4,600
15%	12,300	--	6,400
12% (<u>2</u>)	13,050	1,465	7,020
12% (<u>3</u>)	10,550	1,790	--

Janka side hardness about 670 lb for green material and 860 lb at 12% moisture content. Amsler toughness 214 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be easy to moderately difficult to air dry with little or no degrade or tendency to warp and collapse. No data on kiln schedules available. Shrinkage from green to ovendry: radial 4.8%; tangential 9.5%; volumetric 13.5%.

Working Properties: All species are reported to be easy to work and finish smoothly; some fuzzy grain in one wood from Panama. P. lingue reported to be suitable for steam bending.

Durability: Generally reported to have low durability. P. americana reported to be slightly resistant to dry-wood termite attack.

Preservation: Generally reported to have low permeability and rated moderately difficult to preserve.

Uses: Joinery, furniture, interior construction, millwork, boxes and crates, utility veneers and plywood, flooring and parquetry. Bark of P. lingue used for tanning. P. americana as indicated, produces the avocado.

ADDITIONAL READING

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1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
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1967. The strength properties of timbers. For. Prod. Res. Bull. No. 50. H. M. Stationery Office. London.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

PHOEBE POROSA

IMBUIA

BRAZILIAN-WALNUT

Family: Lauraceae

Other Common Names: Canella imbuia, Embuia, Embuya (Brazil).

Distribution: Grows mostly in the moist Araucaria forests of Paraná and Santa Catharina in southern Brazil, mostly at altitudes of 2,500 to 4,000 ft; forming rather rich stands.

THE TREE The tree attains a maximum height of 130 ft and a trunk diameter of about 6 ft.

THE WOOD General Characteristics: Heartwood yellowish or olive to chocolate-brown, either plain or beautifully variegated and figured; sapwood is gray and usually distinct. Texture rather fine; grain is straight to curly and wavy; luster medium to rather high; spicy resinous scent and taste but losing most of it in drying. Dust arising in working may cause dermatitis.

Weight: Basic specific gravity (ovendry weight/green volume) 0.53; air-dry density 40 pcf.

Mechanical Properties: (First set of data based on 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2) 15%	11,100 13,250	1,120 --	4,620 6,400
Green (3) 12%	7,700 12,100	1,080 1,410	3,380 6,650

Janka side hardness 880 lb for green material and 950 lb at 12% moisture content. Amsler toughness 182 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is reported to be easy to air dry, however thick stock is slow to dry and may develop honeycomb and collapse. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.7%; tangential 6.0%; volumetric 9.0%.

Working Properties: Saws and machines satisfactorily and finishes smoothly. Fine dust generated in working may cause dermatitis.

Durability: Heartwood is reported to be resistant to attack by decay fungi.

Preservation: No information available.

Uses: Fine furniture and cabinet work, paneling, flooring, gunstocks, decorative veneer, and joinery.

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1949. Timbers of the new world. Yale University Press. New Haven, Conn.

PHYLLOSTYLON BRASILIENSIS

SAN DOMINGO-BOXWOOD

Family: Ulmaceae

Other Common Names: Jatia (Cuba), Baitoa (Dominican Republic), Bois blanc (Haiti), Cerón (Mexico), Sabonero (Colombia), Cara tibama (Venezuela), Pau branco (Brazil), Palo de lanza blanco (Paraguay), Palo amarillo (Argentina).

Distribution: Cuba, Hispaniola, and Mexico southward to Colombia, Venezuela, southern Brazil, Paraguay, and Argentina; often in pure stands.

THE TREE Sometimes 80 ft in height with trunk diameters of 30 in.; boles are irregular or fluted.

THE WOOD **General Characteristics:** Heartwood lemon-yellow, sometimes with a tinge of brown, occasionally with dark streaks; sapwood yellowish or nearly white. Texture fine and uniform; grain fairly straight but sometimes irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.77; air-dry density 59 pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: A kiln schedule similar to T2-B2 has been suggested. Other than that, no information available.

Working Properties: Reported to be not difficult to work; readily turned and carved; takes a high polish.

Durability: No information available.

Preservation: No information available.

Uses: Suggested as a substitute for boxwood (Buxus, Gossypiospermum).

ADDITIONAL READING

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New Haven, Conn.

PINUS CARIBAEA

CARIBBEAN PINE

Family: Pinaceae

Other Common Names: Pino (generally in Latin America), Ocote (Mexico, Guatemala, Honduras, Nicaragua).

Distribution; Belize, Honduras, Nicaragua, Guatemala, Bahama Islands, and Cuba; widely introduced as a plantation species throughout the world (Australia, South Africa, Surinam, and elsewhere).

THE TREE Grows to a height of 100 ft and with trunk diameters of 30 to 40 in., occasionally larger. Boles are clear up to 70 ft and with moderate taper.

THE WOOD General Characteristics: Heartwood generally golden-brown to red-brown and distinct from the lighter sapwood. Texture somewhat coarse; grain is typically straight; luster medium; strong resinous odor; growth zones generally clearly defined but often lacking in juvenile wood. Compression wood often present, at least in plantation-grown wood.

Weight: Basic specific gravity (ovendry weight/green volume) varies considerably and may range from 0.34 to 0.68; air-dry density 26 to 51 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	11,190	1,880	4,900
12%	16,690	2,240	8,540
Green (<u>1</u>)	9,000	1,610	4,600
12%	14,700	1,950	7,830
12% (<u>2</u>)	8,830	920	--

Janka side hardness 980 lb for green material and 1,240 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 251 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The timber air seasons rather slowly with a tendency for end splitting in thick stock. Low density plantation wood reported to dry rapidly with no checking and only slight warp. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 6.3%; tangential 7.8%; volumetric 12.9%.

Working Properties: The timber is easy to work with either hand or machine tools; however, high resin contents may cause some downtime due to gumming of cutters and machine tables. Takes nails and screws well and glues satisfactorily.

Durability: Durability and resistance to insect attack varies with resin content, heartwood generally rated moderately durable. Sapwood prone to blue stain.

Preservation: Sapwood is highly permeable and is easily treated by open tank or pressure-vacuum systems. Heartwood is rated as moderately resistant and depends on the resin content.

Uses: General light and heavy construction, carpentry, flooring, joinery, utility poles and railroad crossties (treated), boat building, vats, utility plywood, pulp and paper products.

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Department of Agriculture.
4. Wangaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V. Trop.
Woods No. 103;1-139.

PINUS OOCARPA

OCOTE PINE

Family: Pinaceae

Other Common Names: Pino (generally in Latin America),
Ocote (Mexico, Guatemala, Honduras, Nicaragua).

Distribution: Upper mountain slopes and mountain ridge tops
from northwestern Mexico southward to central Nicaragua;
most extensively in Guatemala, Honduras, and Nicaragua.

THE TREE Tree size varies considerably over its range; heights up to
120 ft; diameters 16 to 32 in., occasionally 50 in.
Boles are cylindrical, straight, and clear to 50 ft and
more.

THE WOOD General Characteristics: Heartwood light reddish-brown;
distinct from the pale yellowish-brown sapwood. Luster
medium; grain straight; texture is somewhat fine and
uniform; odor resinous, taste not distinctive; growth
rings distinct.

Weight: Basic specific gravity (ovendry weight/green volume)
0.55; air-dry density 41 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	7,970	1,740	3,690
12%	14,870	2,250	7,680

Janka side hardness 580 lb for green material and
910 lb at 12% moisture content. Forest Products
Laboratory toughness average for green and dry
material is 120 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood air seasons at a fast to moderate rate with a minimum of seasoning defects. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage from green to ovendry: radial 4.6%; tangential 7.5%; volumetric 12.3%.

Working Properties: The wood is easy to work with hand and machine tools and is comparable with the southern yellow pines.

Durability: The heartwood is classified as very durable in resistance to attack by a white-rot fungus and moderately durable when exposed to a brown rot. The wood does not weather well without the protection of paint or other coatings.

Preservation: Sapwood is permeable; heartwood resistant.

Uses: General purpose construction timber (light and heavy), flooring, box and crate lumber, poles and crossties (treated), and other uses similar to that of the southern yellow pines.

ADDITIONAL READING

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1952. Properties and uses of tropical woods, III.
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PINUS PATULA (PLANTATION)

PATULA PINE

Family: Pinaceae

Other Common Names: Pino (generally in Latin America), Ocote (Mexico).

Distribution: Restricted to eastern Mexico from Tamaulipas to Oaxaca; a favored plantation species in Angola, Kenya, Tanzania, South Africa, and elsewhere in Africa. Planted as well in New Zealand, Australia, India, Brazil, and Argentina.

THE TREE Heights to 115 ft with trunk diameter of 18 to 60 in. are reported. Boles straight and cylindrical.

THE WOOD General Characteristics: Heartwood in plantation-grown material is not easily distinguishable from sapwood; one of the whitest of pines; growth rings distinct; comparatively nonresinous with little odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40 to 0.50; air-dry density 30 to 88pcf.

Mechanical Properties: (First two sets of data based on 2-cm standard (?); third on the 2-in. standard. Sources Angola, Madagascar, Tanzania.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (<u>1</u>)*	14,200	--	5,900
12% (<u>1</u>)	14,000	1,210	5,500
12% (<u>1</u>)	12,000	1,860	7,300

*See "Additional Reading" for reference.

Drying and Shrinkage: Reports are variable; material from 30- to 40-year-old trees seasoned well with little degrade; dries rapidly. Air drying from green (150 to 200% moisture content) to 20% required 2 to 3 weeks for 4/4 stock. Reported to kiln dry rapidly without severe degrade. Kiln schedule similar to T13-C4S has been suggested for 4/4 stock. Shrinkage green to ovendry: radial 4.1%; tangential 7.9%; volumetric 12.6%.

Working Properties: Saws easily and dresses with only a slight tearing of grain around knots; does not bore, mortise, or turn smoothly. Takes and holds nails well and makes an excellent glue joint.

Durability: The wood is not resistant to fungus, insect, or termite attack; prone to blue stain.

Preservation: Reported to be easy to treat by open tank and pressure-vacuum systems.

Uses: Particleboard, excelsior-cement panels, pulp and paper products, food containers, paneling; if juvenile cores are excluded, can be used for light construction, shingles (treated).

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PIPTADENIA PITTIERI
and P. spp.

CARBONERO

Family: Leguminosae

Other Common Names: Hediondo, Bocachico, Rabo de iguana (Columbia), Carbonero, Carabali (Venezuela), Huilca, Tarahuilca (Peru).

Distribution: Abundantly represented in tropical South America; timber described in this group mostly from Venezuela and Colombia.

THE TREE A medium-sized tree to about 65 ft in height with trunk diameters to 2 ft; boles straight and clear to 30 to 50 ft.

THE WOOD General Characteristics: Heartwood brown, yellow-brown, or reddish-brown; sapwood light brown to whitish, not always clearly demarcated. Texture fine to medium; grain straight to irregular; luster high; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57 to 0.67; air-dry density 44 to 49 pcf.

Mechanical Properties: (First two sets of data based on the 1-in. standard; the third set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	15,400	1,960	8,250
12% (3)	17,000	--	8,600
12% (1)	19,700	2,480	9,220

Janka side hardness 1,550 to 1,680 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rather slowly and prone to severe checking, unless air dried carefully. No kiln schedule information available. Shrinkage green to ovendry: radial 2.6 to 4.4%; tangential 6.4 to 7.5%; volumetric 9.0 to 11.6%.

Working Properties: Rated as fair to good in all machining operations. However, will tend to tear when planing irregular grain.

Durability: Generally reported to be vulnerable to attack by decay fungi and insects.

Preservation: Heartwood treatability varies with species; absorptions are fair to good using a pressure-vacuum system; sapwood is responsive.

Uses: Heavy construction, posts, railroad crossties (treated), furniture, flooring, turnery.

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PIRATINERA GUIANENSIS
SYN. BROSIMUM GUIANENSIS

LETTERWOOD
SNAKEWOOD

Family: Moraceae

Other Common Names: Cacique carey (Panama), Palo de oro (Venezuela), Burokoro, Tibicus (Guyana), Letterhout (Surinam), Bois d'amourette (French Guiana), Gateado, Muirapenima (Brazil).

Distribution: Guianas, Trinidad, and the Amazon region; a rare to occasional tree.

THE TREE Unbuttressed small tree, up to 80 ft in height with trunk diameters of 12 to 20 in.; bole is cylindrical and clear for 40 to 50 ft.

THE WOOD General Characteristics: Heartwood dark red to reddish-brown with irregular radial black markings or with black vertical stripes alone or in conjunction with the speckles; sapwood very thick, yellowish-white, line of demarcation often irregular and not very sharp. Luster medium to high; texture fine and uniform; grain straight; odorless and tasteless.

Weight: Basic specific gravity (green volume/ovendry weight) 0.82 to 1.10; air-dry density 63 to 84 pcf.

Mechanical Properties: No strength values available but reported to be a strong hardwood that splits rather easily, heartwood is rather brittle.

Drying and Shrinkage: Should be dried carefully and in small pieces; shrinkage is reported to be rather high.

Working Properties: Works with difficulty because of hardness; turns well and takes a beautiful polish.

Durability: Heartwood very resistant to attack by decay fungi and dry-wood termites.

Preservation: No information available.

Uses: Inlay, turnery, fancy handles for cutlery, violin bows, walking sticks, drum sticks, butts of fishing rods.

ADDITIONAL READING

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1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
2. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.
3. Vink, A. T.
1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.

PITHECELLOBIUM SAMAN
SYN. SAMANEA SAMAN

SAMÁN
RAINTREE

Family: Leguminosae

Other Common Names: Dormilón (Puerto Rico), Algarrobo (Cuba, Mexico, Guatemala), Cenícero (El Salvador, Costa Rica), Samaguare (Colombia), Lara, Carabali (Venezuela), Huacamayo-chico (Peru), Monkeypod (Hawaii).

Distribution: Native to southern Mexico (Yucatan Peninsula) and Guatemala southward to Peru, Bolivia, and Brazil. The tree is widely planted and naturalized throughout the West Indies, Mexico southward, and in other tropical regions of the world; makes its best growth on well-drained fertile soils.

THE TREE Attains heights of 100 to 125 ft and trunk diameters of 3 to 4 ft; when grown in the open, develops a massive wide-spreading crown and a short thick trunk.

THE WOOD **General Characteristics:** Heartwood dark walnut to dark chocolate-brown which turns a light to golden-brown with darker streaks when seasoned; sapwood is thin and yellowish and clearly differentiated from the heartwood. Texture medium to coarse; luster medium; either straight or cross grained; without distinctive odor or taste.

Weight; Basic specific gravity (ovendry weight/green volume) 0.48; air-dry density 35pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	8,100	910	3,760
12%	8,860	1,100	5,070

Janka side hardness 750 lb for green material and 850 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 99 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to air season rather poorly with little or no checking but moderate to severe warp. No data available on kiln schedules. Shrinkage green to ovendry: radial 2.0%; tangential 3.4%; volumetric 6.0%; exceptionally low for a wood of this density.

Working Properties: The wood saws and machines easily but may develop torn and fuzzy grain when working pieces with interlocked grain; takes an excellent finish.

Durability: The wood is rated durable to very durable in resistance to attack by a white-rot and brown-rot fungus and rated resistant to attack by dry-wood termites.

Preservation: No information available.

Uses: Fine furniture and cabinet work, millwork, decorative veneer, joinery. The tree is highly favored for its shade and nutritious pods eaten by cattle, hogs, and goats.

ADDITIONAL READING

1. Longwood, F. R.
1961. Puerto Rican woods: Their machining, seasoning, and related characteristics. Agriculture Handbook No. 205. U.S. Department of Agriculture.
2. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
3. Wangaard, F. F., A. Koehler, and A. F. Muschler.
1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

PLATYMICCIUM spp.

TREBOL
MACAWOOD

Family: Leguminosae

Other Common Names: Granadillo (Mexico, Belize, El Salvador, Honduras), Coyote, Cristobal (Costa Rica), Trebol, Guayacan trebol (Colombia), Roble (Venezuela), Koenatepi (Surinam), Macacauba, Jacaranda do brejo (Brazil), Cumaseba (Peru).

Distribution: Continental tropical America from southern Mexico to the Brazilian Amazon region, and Trinidad.

THE TREE Heights to 80 ft with trunk diameters of 28 to 42 in.; boles are straight, cylindrical, and clear to 60 ft; buttressed.

THE WOOD **General Characteristics:** Heartwood bright red to reddish or purplish brown, more or less distinctly striped; darker specimens look waxy; sharply demarcated from the nearly white sapwood. Luster medium to high; grain straight to roey; texture mostly medium to fine, sometimes coarse; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.73 to 0.94; air-dry density 55 to 73 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, the second set on the 2-cm standard, and the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)* 12%	22,320 27,600	3,020 3,200	10,540 16,100
Green (<u>2</u>) 15%	15,900 17,500	2,130 --	7,460 8,940
12% (<u>1</u>)	16,800	2,500	9,800

Janka side hardness at 12% moisture content ranges from 1,710 lb to 3,200 lb. Amsler toughness at 12% moisture content is 242 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to air dry slowly with a slight tendency to warp and check. No data available on kiln schedules. Shrinkage green to ovendry: radial 2.7%; tangential 3.5%; volumetric 6.5% (*P. pinnatum*); values are remarkably low for a wood of this density.

Working Properties: Not very difficult to work, finishes smoothly, and takes a high polish.

Durability: Heartwood reported to be highly resistant to attack by decay fungi and insects; resistance to dry-wood termites is rated very high.

Preservation: Heartwood is highly resistant to preservation treatments; sapwood responds with good absorption, but irregular penetration.

Uses: Fine furniture and cabinet work, decorative veneers, musical instruments, turnery, joinery, specialty items (violin bows, billiard cues).

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Instituto de Pesquisas Tecnologicas.
1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
3. Vink, A. T.
1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.
4. Wangaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

PODOCARPUS SPP.

PODOCARP
MANIO

Family: Podocarpaceae

Other Common Names: Ciprés (Guatemala, Honduras), Cipricillo, Cipresillo lorito (Costa Rica), Pino chaquiro (Colombia), Pino castañeto (Venezuela), Pinho bravo (Brazil); Maníu, Maño (Chile).

Distribution: Various species in mountainous areas from the West Indies and southern Mexico south to southern Chile.

THE TREE Varies considerably with species, ranging from heights of 60 ft and diameters 10 to 16 in. to heights of 100 ft and diameters up to 40 in. Clear straight boles often somewhat fluted but without buttresses.

THE WOOD **General Characteristics:** Heartwood pale yellow to yellowish-brown; not distinct from sapwood. Texture fine and uniform without conspicuous zones of latewood; somewhat lustrous; grain usually straight but may be slightly interlocked; odor or taste absent or not distinctive in seasoned wood.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.37 to 0.55; air-dry density 28 to 42 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard; the second on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	8,700	1,250	4,320
12%	11,800	1,380	6,980
Green (<u>2</u>)	6,500	780	2,970
15%	8,550	--	4,600
12% (<u>4</u>)	15,600	2,080	--

Janka side hardness at 12% moisture content 760 lb. Amsler toughness at 15% moisture content is 70 in.-lb (2-cm specimen) for Brazilian material.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons rapidly with little or no warping or checking. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4 (P. guatemalensis). Shrinkage green to ovendry: radial 2.6%; tangential 6.4%; volumetric 9.6%. Movement in service is rated small.

Working Properties: The timber works easily with hand and power tools; nails easily and takes stain, varnish, and paint satisfactorily.

Durability: Heartwood from trees grown in Belize reported to be moderately durable in ground contact under tropical exposure. Durability of other species from other areas reported as low.

Preservation: Reported to have good penetration and absorption if treated by a pressure-vacuum system.

Uses: Joinery, millwork, furniture components, boxes and crates, general construction, veneer and plywood, pulp and paper, patternmaking.

ADDITIONAL READING

1. Armstrong, F. H.
1953. The strength properties of timbers. Dept. Sci. and Ind. Res., For. Prod. Res. Bull. No. 28.
H. M. Stationery Office. London.
2. Instituto de Pesquisas Tecnologicas.
1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
3. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
4. Slooten, H. J. van der, I. Acosta-Contreras, and P. S. Aas.
1970. Maderas latinoamericanas. III. Podocarpus standleyi, Podocarpus oleifolius, Drimys granadensis, Magnolia poasana y Didymopanax pittieri. Turrialba 20(1):105-115.

POULSENIA ARMATA

MASTATE

Family: Moraceae

Other Common Names: Ababábite, Carnero (Mexico), Tumu (Honduras, Nicaragua), Cocuá, Mastate (Panama), Corbón, Cucúa (Colombia), Majagua (Ecuador).

Distribution: From Vera Cruz, Mexico, through Central America and southward to Colombia, Ecuador, and Bolivia.

THE TREE Sometimes up to 100 ft tall with trunk diameters to 37 in. above the buttress.

THE WOOD **General Characteristics:** Heartwood absent or not clearly distinguishable from the yellowish-white sapwood which becomes brownish or oatmeal on exposure. Luster rather high; texture coarse; grain straight to interlocked; without distinctive odor or taste. A silica content of 7.32% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.33; air-dry density 25pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	6,960	965	--

Janka side hardness 360 lb.

*See "Additional Reading" for reference.

Drying and Shrinkage: Drying rate is reported to be moderate, dries without degrade due to warping or checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.8%; tangential 6.9%.

Working Properties: Saws wooly when green; wood difficult to plane smoothly if grain is interlocked. Dulls tools rapidly because of the very high silica content.

Durability: Reported to be perishable in contact with the ground.

Preservation: No information available.

Uses: General construction work (interior). Inner bark has long been used to make blankets, mats, and clothing.

ADDITIONAL READING

1. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press. New Haven, Conn.
2. Slooten, H. J. van der, and M. E. Gonzalez.
1971. Maderas latinoamericanas VI. Bursera simaruba, Poulsenia armata, Pterocarpus officinalis, y Ficus werckleana. Turrialba 21(1):69-76.

PRADOSIA spp.

CHUPÓN

Family: Sapotaceae

Other Common Names: Chupón, Chupón torito, Toco (Venezuela), Abihy, Burahem, Paracuhuba doce (Brazil).

Distribution: Amazon basin and extending into the Guianas, Venezuela, Colombia, and Ecuador.

THE TREE Attains a height of 100 ft and diameters of about 40 in.

THE WOOD **General Characteristics:** Heartwood yellowish- or grayish-brown with more or less reddish cast; sapwood narrow, yellowish or grayish, not always distinct from the heartwood. Texture fine to medium, unkform; grain usually straight, sometimes interlocked; luster low; without characteristic odor but taste sometimes bitter or astringent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.68; air-dry density 52 pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,420	1,740	4,360
12%	17,770	2,320	7,660

Janka side hardness 1,440 lb for green material and 1,880 lb for dry. Forest Products Laboratory toughness average for green and dry material is 230 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Drying is rapid but may result in severe checking and moderate warp; a reduced drying rate may minimize degrade. No information on kiln schedules. Shrinkage green to ovendry: radial 4.4%; tangential 10.5%; volumetric 14.8%.

Working Properties: Works easily and finishes to a smooth surface. Good steam-bending properties.

Durability: Heartwood is rated durable in test exposures to white-rot and brown-rot organisms, but is not suggested for uses where high durability is required.

Preservation: No information available, but is reported to be resistant to moisture absorption.

Uses: General construction, heavy-duty flooring, also suggested for tight cooperage, tool handles.

ADDITIONAL READING

1. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale Univ. Press,
New Haven, Conn.
2. Wangaard, F. F., and A. F. Muschler.
1952. Properties and uses of tropical woods, III. Trop.
Woods No. 98:1-190.

PRIORIA COPAIFERA

CATIVO

Family: Leguminosae

Other Common Names: Amansamujer, Copachú (Colombia), Camibar (Costa Rica), Muramo, Curucai (Venezuela).

Distribution: Lowland areas from Nicaragua to Colombia, often in nearly pure stands.

THE TREE Heights are usually 75 to 100 ft with clear boles of 40 to 50 ft; commonly range from 18 to 40 in. in diameter with occasional specimens reaching 48 to 60 in.

THE WOOD General Characteristics: Heartwood medium to light brown, often attractively streaked; sharply demarcated from the thick sapwood which is pinkish to white when fresh becoming dingy on the surface because of oily exudations. Texture rather fine and uniform; straight grained; superficially dull but with golden luster beneath; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40; air-dry density 30pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	5,920	940	2,460
12%	8,560	1,110	4,290
12% (<u>1</u>)	8,900	1,180	--

Janka side hardness 440 lb for green material and 630 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 88 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Wood dries rapidly with no checking and only slight warping. Collapse is reported to occur sometimes in the darker streaks in the heartwood, particularly during kiln drying. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Control of gum exudates by use of high kiln temperatures is reported. Shrinkage green to ovendry: radial 2.4%; tangential 5.3%; volumetric 8.9%.

Working Properties: Tends to be wooly when sawed green; wood machines well in all operations when dry mostly with smooth surfaces, sometimes with a slight tendency to fuzziness. Easy to glue. Requires care in finishing because of gum content. Fair to good in steambending quality.

Durability: Generally rated as nondurable, particularly in resistance to white rot.

Preservation: The wood is reported to be easy to preserve.

Uses: Interior trim, furniture and cabinet work, joinery, veneer and plywood, millwork; used to prepare resin-stabilized veneer for pattern stock.

ADDITIONAL READING

1. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
2. Kukachka, B. F.
1965. Priaria copaifera. Cativo. USDA For. Serv. Res. Note FPL-095. For. Prod. Lab., Madison, Wis.
3. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press, New Haven, Conn.
4. Wanggaard, F. F., and A. F. Muschler.
1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

PROTIUM SPP.

KUROKAI
COPAL

Family: Burseraceae

Other Common Names: Latilla, Pom (Mexico), Alcanfor, Fontole (Honduras), Caraño, Chutra (Panama), Anime, Caraño (Colombia), Bálsamo, Tacamahaco (Venezuela), Kurokai (Guyana), Bois encens (French Guiana), Breu branco, Breu preto, Sucuriúba (Brazil).

Distribution: Throughout tropical America but most abundantly represented in the Amazon basin; frequent in the marsh forests of Guyana.

THE TREE Usually up to 90 ft in height; diameters mostly 16 to 20 in., sometimes up to 40 in. Some species with low flat buttresses and fluted boles.

THE WOOD **General Characteristics:** Heartwood brown or reddish-brown, sometimes with irregularly spaced darker brown lines; not always sharply demarcated from the pale buff to pinkish sapwood. Texture varies from rather fine to fairly coarse; luster rather high; grain straight to very irregular and interlocked; dry specimens without distinctive odor or taste. Silica reported for some species.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.45 to 0.61; air-dry density 33 to 45 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard, the second set on the 2-in. standard, and the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	11,000 16,850	1,465 1,765	5,280 9,200
Green (<u>2</u>) 12%	9,300 11,800	1,510 1,650	4,370 6,960
12% (<u>1</u>)	15,700	1,860	8,700

Janka side hardness at 12% moisture content ranged from 720 lb to 1,280 lb. Forest Products Laboratory toughness at 12% moisture content is 167 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reports vary from fairly easy to air dry to moderately difficult. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.2%; tangential 6.8%; volumetric 10.7%.

Working Properties: Logs should be debarked prior to sawing to avoid resin accumulation on cutters and equipment. Dry wood works easily and rates fair to good in all operations. Cuts easily into veneers but tends to buckle on drying. Some species abrasive because of silica content.

Durability: Generally reported to have low resistance to attack by decay fungi and vulnerable to dry-wood termites. No appreciable resistance to marine borers.

Preservation: Generally heartwood is reported as difficult to treat with pressure-vacuum systems; sapwood is responsive.

Uses: Furniture, millwork, veneer and plywood, general construction, particleboard, a possible substitute for birch. Incense-like resin obtained from wounds to the bark and marketed as "elemi".

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Kynoch, W., and N. A. Norton.
1938. Mechanical properties of certain tropical woods, chiefly from South America. Univ. of Mich. School of Forestry and Conservation Bull. No. 7.
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1967. The strength properties of timbers. For. Prod. Res. Bull. No. 50. H. M. Stationery Office. London.
4. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.

PSEUDOSAMANEA GUACHAPELE

GUACHAPELE
FRIJOLILLO

Family: Leguminosae

Other Common Names: Cadeno (Guatemala), Frijolillo (Honduras), Tabaca, Guamarillo (Colombia), Samanigua (Venezuela), Guachapele (Ecuador).

Distribution: From Guatemala southward to Venezuela and Ecuador. Generally grows in dry areas and seeds naturally in pastures and abandoned fields. Often used for shade in coffee plantations.

THE TREE A large tree with a spreading crown, well-formed bole without significant buttresses.

THE WOOD General Characteristics: Heartwood light orange-brown when freshly cut becoming yellow-brown or brown with a golden luster on drying; rather sharply demarcated from the thin whitish sapwood. Texture medium to rather coarse; grain generally interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.56; air-dry density 41 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	8,190	1,200	3,930
12%	10,750	1,150	6,570

Janka side hardness 1,030 lb when green and 1,040 lb at 12% moisture content. Forest Products Laboratory toughness average for green and air-dry material is 130 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to be somewhat difficult to air season. A moderate rate of drying resulted in some warping and slight checking. No data available on kiln schedules. Shrinkage green to oven-dry: radial 2.9%; tangential 4.5%; volumetric 7.6%; values are unusually low for a wood of this density.

Working Properties: The wood is easy to work and surfaces finish smoothly after sanding; sawn surfaces are somewhat woolly.

Durability: Heartwood is rated durable to very durable upon exposure to both white-rot and brown-rot fungi. Reported to have excellent weathering characteristics.

Preservation: Heartwood is highly resistant to moisture absorption and thus presumed to be nontreatable.

Uses: Shipbuilding (planking, ribs, decking), railroad crossties, general construction, flooring, decorative veneers, furniture components.

ADDITIONAL READING

1. Record, S. J., and R. W. Hess.
1949. Timbers of the new world. Yale University Press.
New Haven, Conn.
2. Wangaard, F. F., and A. F. Muschler.
1952. Properties and uses of tropical woods, III.
Trop. Woods No. 98:1-190.

PTEROCARPUS spp.

SANGRE

Family: Leguminosae

Other Common Names: Sangre de drago (generally in Latin America), Palo de pollo (Puerto Rico), Sangrillo (Costa Rica), Huevos de gato (Panama), Yaya sangre (Colombia), Lagunero (Venezuela), Bébé (Surinam), Angú, Mututi, Pau sangua (Brazil), Nogal falso (Bolivia).

Distribution: Throughout tropical America from the West Indies and southern Mexico to northern Argentina. Some species in swamplands, others in uplands, and still others common on abandoned farmlands and on cutover forest lands.

THE TREE Varies with species up to 90 ft in height with diameters to 36 in., commonly to 16 in. In some, bole is usually fluted with high sinuous, irregular plank buttresses.

THE WOOD **General Characteristics:** Wood yellowish or whitish; sapwood indistinct; traumatic heartwood dark brown or purplish. Texture medium to coarse; luster medium; grain straight to irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies considerably with species from 0.28 to 0.60; air-dry density 22 to 44pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	9,580 16,020	1,580 2,000	4,140 7,390
12% (<u>2</u>)	7,100	1,090	--
12% (<u>1</u>)	10,450	1,430	5,420

Janka side hardness at 12% moisture content varies with species from 275 lb to 1,380 lb. Forest Products Laboratory toughness average for green and dry material is 220 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Most species are relatively easy to air season with only slight checking and moderate warp, particularly in thinner boards. No data on kiln schedules are available. Shrinkage from green to ovendry: radial 3.9%; tangential 6.8%; volumetric 10.8%.

Working Properties: Easy to work and finishes smoothly in all operations. P. vernalis reported to cut well into veneers for plywood. The same species has excellent steam-bending characteristics.

Durability: Generally reported to be very susceptible to attack by decay fungi. In laboratory evaluations the decay resistance of P. vernalis is reported to be very variable.

Preservation: Reported to be very easy to treat using either open tank or pressure-vacuum systems.

Uses: Rough construction lumber, particleboard and fiberboard, general carpentry, plywood, and furniture components.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del área del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1971. Maderas latinoamericanas VI. Bursera simaruba, Paulsenia armata, Pterocarpus officinalis, y Ficus werckleana. Turrialba 21(1):69-76.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

PTEROGYNE NITENS

AMENDOIM
VIRARO

Family: Leguminosae

Other Common Names: Amendoim, Ibiráro, Pau fava (Brazil), Guiáro, Ibiraró, Viraró (Argentina).

Distribution: Argentina, southern Paraguay, and Brazil; scattered occurrence.

THE TREE Attains a maximum height of over 100 ft but more commonly not over 75 ft with a well-formed trunk, diameter 2 to 3 ft, exceptionally 4 ft.

THE WOOD General Characteristics: Heartwood reddish-brown suggesting mahogany often with darker striping; not sharply demarcated from the yellowish-brown sapwood. Luster medium to high; texture medium; grain often roey; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.66; air-dry density 50 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)* 15%	11,900 16,900	1,610 --	5,650 7,660

Janka side hardness for green material 1,340 lb.
Amsler toughness 354 in.-lb at 15% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: No data available on drying characteristics or on kiln schedules. Shrinkage green to ovendry: radial 3.4%; tangential 6.0%; volumetric 10.0%. Reported to hold its place well after manufacture.

Working Properties: Rather easily worked and finishing very smoothly.

Durability: Reported to be fairly durable.

Preservation: No information available.

Uses: Fine furniture and cabinet work, turnery, interior trim, cooperage, and steam-bent work.

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1956. Tabelas de resultados obtidos para madeiras nacionais. Bol. Inst. Pesqu. tec. S. Paulo No. 31.
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1949. Timbers of the new world. Yale University Press. New Haven, Conn.
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1956. Maderas y bosques argentinos. Editorial Acme S.A. C. I. Maipu 92, Buenos Aires.

QUALEA SPP.

MANDIOQUEIRA
GRONFOELOE

Family: Vochysiaceae

Other Common Names: Florecillo (Venezuela), Kouali, Grignon fou (French Guiana), Gronfoeloe (Surinam), Mandio, Mandioqueira, Quaruba (Brazil).

Distribution: The genus is represented throughout tropical America from southern Mexico to Peru, but most abundantly in the Guianas and Brazil.

THE TREE Trees to heights of 100 ft, sometimes attaining 200 ft; with diameters to 25 in., reaching 40 in. occasionally. Clear stems extend to 60 or 70 ft. Light to heavily buttressed.

THE WOOD General Characteristics: Heartwood pinkish-brown to reddish-brown, occasionally olive-brown; sometimes sharply demarcated from the grayish or yellowish sapwood. Luster golden in some species, medium in others; texture medium to decidedly coarse; grain straight to interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.49 to 0.60; air-dry density 37 to 46 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	10,510 14,610	2,030 2,200	5,200 7,570
Green (<u>1</u>) 12%	11,700 20,000	1,850 2,560	6,250 11,800
12% (<u>2</u>)	18,000	2,580	--

Janka side hardness for air-dry material ranges from 900 lb to 1,730 lb. Forest Products Laboratory toughness average for green and dry material is 156 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is reported to be moderately difficult to air season and kiln dry. It seasons rapidly but with some warping and slight checking. Care in stacking and mild drying conditions are suggested. Kiln schedule T3-D2 may be used for 4/4 stock and T3-D1 for 8/4. Shrinkage green to oven-dry: radial 4.4%; tangential 8.4%; volumetric 11.4%.

Working Properties: The wood is generally rated as moderately difficult to work particularly when roey grain is present; saws and other cutting edges dull rather quickly because of silica accumulations, 0.10% is reported. Glues satisfactorily.

Durability: Heartwood somewhat variable in decay resistance, generally is rated as moderately durable and is not suitable for continuously damp conditions. Also prone to staining during drying. Weathering characteristics are rated as only fair and severe surface checking develops when unpainted wood is exposed. *Q. albiflora* is rated as moderately resistant to dry-wood termites.

Preservation: The wood is rated as moderately difficult to rather easy to preserve, varying with species.

Uses: Joinery, millwork, furniture, veneer and plywood, general construction, and flooring.

ADDITIONAL READING

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1967. The strength properties of timbers. For. Prod. Res. Bull. No. 50. H. M. Stationery Office, London.
2. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
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1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

QUERCUS SPP.

ROBLE, ENCINO, OAK

Family: Fagaceae

Other Common Names: Ahuatl, Cucharillo, Encino (Mexico), Roblecito (Guatemala), Encino negro (Honduras), Roble encino, Roble colorado (Costa Rica), Mamecillo (Panama), Roble, Roble amarillo (Colombia).

Distribution: In tropical America from Mexico southward through Central America to Colombia. In the lower latitudes confined mostly to the high mountains.

THE TREE A large tree that may reach a height of 90 ft and a diameter of 5 ft; more commonly with a height to 65 ft and diameters up to 30 in. Stems are straight and cylindrical.

THE WOOD General Characteristics: Heartwood yellowish-brown to reddish-brown; sapwood whitish to light brown. Grain is generally straight; texture coarse; luster usually low; without distinctive odor or taste when seasoned. Because of the broad rays, the wood is highly figured as in the temperate oaks but pores in radial or diagonal rows rather than ring-porous.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.57 to 0.82; air-dry density 44 to 62 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (<u>1</u>)*	22,400	2,960	--
12% (<u>2</u>)	16,400	2,840	--
12% (<u>3</u>)	29,000	--	--

Janka side hardness for dry material ranges from 1,600 lb to 3,200 lb.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is very difficult to air season, prone to severe checking, warping, and collapse; rate of drying is slow. To minimize drying problems, lumber should be quarter-sawn. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry (including collapse): radial 6.4%; tangential 11.7%; volumetric 18.5%.

Working Properties: Generally reported to be difficult to work, particularly the high density species. Tangential surfaces can be finished smoothly but there is a tendency to "tear-out" on radial surfaces.

Durability: Heartwood is reported to have a high natural durability; sapwood is prone to insect and fungal attack.

Preservation: The wood is rated as difficult to treat.

Uses: Flooring, railroad crossties, construction, mine timbers, tight cooperage, boat and ship construction, decorative veneer, and charcoal.

ADDITIONAL READING

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1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
2. Slooten, H. J. van der, I. Acosta-Contreras, and P. S. Aas.
1969. Maderas latinoamericanas. II. Quercus aaata, Q. costaricensis, y Q. eugeniaefolia. Turrialba 19(3):412-418.
3. Villamil G., F. (ed.).
1971. Maderas colombianas. Proexpo, Bogotá.

RHEEDIA SPP.

PACURI
REMELENTO

Family: Guttiferae

Other Common Names: Palo de cruz (Puerto Rico), Limoncillo (Mexico), Caimito (Honduras), Madroño (Colombia, Venezuela), Pakoeli (Surinam), Remelento, Bacury, Pacuru (Brazil), Charichuélá (Peru).

Distribution: Widely distributed in tropical America from the West Indies and Mexico in the north to Argentina.

THE TREE Medium to large-sized trees up to 100 ft high with stem diameters to 36 in. and more. Cylindrical boles clear to 65 ft above the few low thick buttresses.

THE WOOD **General Characteristics:** Heartwood dark yellow-brown, grayish- or pinkish-brown merging gradually into the sapwood; surfaces sometimes specked with resinous exudations. Luster medium to rather low; grain straight to irregular and roey; texture medium to coarse; odorless and tasteless.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72; air-dry density 55 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	13,000	1,800	5,850
15%	18,800	--	8,650
12% (<u>2</u>)	18,400	--	9,050

Janka side hardness for green material 1,250 lb.
Amsler toughness at 15% moisture content 425 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly but is reported to be moderately difficult to air season; tending to warp and check. No data available on kiln schedules. Shrinkage green to ovendry is very high: radial 4.0%; tangential 14.2%; volumetric 16.6%. Movement also reported as rather high.

Working Properties: Reports on workability vary with species from moderate to high resistance to cutting to machining fairly well; reports on ease of finishing also variable.

Durability: Species in Surinam rated durable to attack by decay fungi and fairly resistant to dry wood termites. Species in Colombia are resistant to a brown-rot fungus but not the white-rot in a laboratory assay. Under field conditions the wood was susceptible to decay and attack by insects.

Preservation: Reported to have adequate absorption using either pressure or open tank systems; however penetration is irregular.

Uses: Furniture, flooring (quarter sawn), heavy construction, and general carpentry.

ADDITIONAL READING

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2. Laboratorio Nacional de Productos Forestales.
1974. Características, propiedades, y usos de 10⁴ maderas de los altos llanos occidentalis. Universidad de Los Andes, Merida.
3. Vink, A. T.
1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.

RHIZOPHORA MANGLE

MANGLE COLORADO RED MANGROVE

Family: Rhizophoraceae

Other Common Names: Candelón, Mangle dulce (Mexico), Mangle rojo (Colombia), Purga (Venezuela), Apareiba, Mangué sapateiro (Brazil), Mangle geli (Ecuador).

Distribution: Coastal areas and brackish streambanks from central and southern Florida southward to Ecuador, northwestern Peru, and Brazil, including the West Indies. Also in Melanesia, Polynesia, and the Galapagos Islands.

THE TREE On favorable sites trees may reach heights of 100 ft with trunk diameters 18 to 24, sometimes up to 36 in., with clear boles to 30 to 40 ft. Stems develop stilt-like roots forming impenetrable thickets.

THE WOOD **General Characteristics:** Heartwood light red, deepening to dark red or reddish-brown, sometimes purplish; uniform or more or less striped; rather sharply defined from the yellowish, grayish, or pinkish sapwood. Texture fine to medium; grain straight to irregular; luster low; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.89; air-dry density 67 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	15,200	2,300	6,490
12%	21,700	2,950	10,750
12% (<u>2</u>)	24,000	3,260	--
15% (<u>1</u>)	28,400	3,480	13,500

Janka side hardness 2,240 lb for green material and 2,760 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Drying rate is moderate during air seasoning; warp is severe as is surface and end checking. No data available on kiln schedules. Shrinkage green to ovendry; radial 5.0%; tangential 10.7%; volumetric 14.3%.

Working Properties: Generally difficult to work because of its high density; can finish smoothly where grain is straight.

Durability: Heartwood is reported to be resistant to attack by decay fungi but not to marine borers and dry-wood termites.

Preservation: Both heartwood and sapwood resistant to impregnation.

Uses: Boat construction, general heavy construction, charcoal, railroad crossties, turnery, bark has a high tannin content (30% based on ovendry weight) and is used commercially.

ADDITIONAL READING

1. Bascope, F. et al.
1959. Los manglares en America. Descripciones de arboles forestales No. 5. Instituto Forestal Latino Americano de Investigaciones y Capacitacion.
2. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
3. Markwardt, L. J., and T.R.C. Wilson.
1935. Strength and related properties of woods grown in the United States. Technical Bulletin No. 479. U.S. Department of Agriculture.

SAPIUM SPP.

LECHERO
CURUPI

Family: Euphorbiaceae

Other Common Names: Hierba mala, Mago (Mexico), Olivo (Panama), Palo de leche, Caucho (Colombia), Lechero (Venezuela), Pau de leite, Tapurú (Brazil), Caucho-mashán (Peru), Curupi, Lecherón (Argentina).

Distribution: Throughout tropical America from Mexico and the West Indies to Uruguay and Argentina.

THE TREE May attain heights of 90 to 115 ft with a well-formed trunk sometimes 36 in. in diameter. In some species, the inner bark contains a poisonous latex.

THE WOOD **General Characteristics:** Heartwood whitish, yellowish, or light brown not distinct from the cream-colored sapwood. Grain is straight to slightly interlocked; luster is low; texture medium; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.47; air-dry density 36pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	7,700	1,480	3,200
12%	10,790	1,680	6,120
12% (2)	12,000	2,140	--
12% (1)	11,900	--	6,150

Janka side hardness 520 lb for green material and 700 lb for dry. Forest Products Laboratory toughness average for green and dry material 84 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is reported to air dry rapidly with only slight warping and checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.3%; tangential 6.6%; volumetric 9.2%.

Working Properties: The wood works easily because of its low density; sometimes surfaces are fuzzy but generally machines smoothly. One report indicates difficulty in sanding.

Durability: The wood has low resistance to decay and insect attack, including dry-wood termites. Lumber is particularly prone to blue stain.

Preservation: Both heartwood and sapwood are easy to treat; high absorptions and complete penetration are obtained using either pressure-vacuum or open tank systems.

Uses: Plywood, fiberboard, particleboard, general carpentry, millwork, utility furniture, boxes and crates.

ADDITIONAL READING

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1974. Caracteristicas, propiedades, y usos de 104 maderas de los altos llanos occidental. Universidad de Los Andes, Merida.
2. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

SCHINOPSIS spp.

QUEBRACHO

Family: Anacardiaceae

Other Common Names: Baraúva, Braúna, Quebracho hembra (Brazil),
Quebracho colorado, Q. chaqueño, Q. santiagueno (Argentina).

Distribution: Botanical range extends over northern Argentina,
western Paraguay, a small portion of Bolivia, and to the
interior of the state of Bahia in Brazil.

THE TREE Scrubby growth 30 to 50 ft high; 12 to 36 in. in diameter.
Trunks are often bent and twisted and swollen at the base.
S. balansae reported to reach a height of 80 ft and a
diameter of 60 in.

THE WOOD General Characteristics: Heartwood light red, deepening to
brick red, uniform or with black streaks; distinct but
not sharply demarcated from the yellowish sapwood.
Luster low to medium; texture fine and uniform; grain
irregular, often roey; odor not distinctive, taste
astringent. Heartwood contains 20 to 30% tannin.

Weight: Basic specific gravity (ovendry weight/green volume)
1.00; air-dry density 75 pcf.

Mechanical Properties: (Standard not known)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
15% (2)*	19,800	2,190	--
15% (2)	13,800	1,950	8,900

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to check and warp severely, particularly when cut into thin boards. A kiln schedule similar to Tl-B1 has been suggested. No data available on shrinkage values.

Working Properties: Very difficult to work, especially when dry but takes a high natural polish.

Durability: Highly durable, though standing trees are often defective as a result of heart rot.

Preservation: No data available.

Uses: Tannin extraction, railroad crossties, heavy construction, fenceposts, poles, fuel.

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1956. Maderas y bosques argentinos. Editorial
Acme S. A. C. I. Maipú, Buenos Aires.

SCLEROLOBIUM SPP.

DJEDOE
YAWAREDAN

Family: Leguminosae

Other Common Names: Jawaledan, Yawarridana (Guyana), Rode Djedoe, Witte Djedoe, Djaditja (Surinam) Passariuva, Tachy, Tachyrana (Brazil).

Distribution: Tropical Brazil, eastern Peru, the Guianas, and Venezuela.

THE TREE Sometimes reaches a height of 130 ft with diameters to 28 in. Boles are cylindrical and clear to 60 ft and more.

THE WOOD General Characteristics: Heartwood pale to rather dark brown with a pinkish, yellowish, or olive tinge; scarcely distinct from the sapwood. Luster high; texture medium to coarse; grain straight to interlocked; tasteless but some species have a mild scent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.47; air-dry density 35pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard, second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	7,750 13,150	1,750 2,040	3,850 6,530
Green (<u>1</u>) 15%	8,150 11,750	1,300 --	3,620 5,800
15% (<u>2</u>)	10,380	1,460	5,550

Janka side hardness about 700 lb for dry material. Forest Products Laboratory toughness average for green and dry material is 159 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be easy to air season in that drying rates are rapid; however, this does cause moderate warp and slight checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.4%; tangential 8.9%; volumetric 12.3%.

Working Properties: The wood is easily worked; sawn surfaces are somewhat fuzzy; planing usually results in chipped and torn grain, particularly on quartered surfaces of roey material. Dust from machining operations reported to be extremely irritating.

Durability: Pure culture decay studies show the heartwood to be durable with respect to a white-rot fungus; however, wood of this genus is generally reported to be low in decay resistance and susceptible to dry-wood termite attack.

Preservation: Reported to be difficult to impregnate.

Uses: Light construction under cover, utility furniture, boxes and crates, suggested as a veneer wood.

ADDITIONAL READING

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1957. [Tests about the most important mechanical and physical properties of 41 Surinam wood species.] Royal Tropical Institute. Afdeling Tropische Producten No. 46.
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1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

SICKINGIA spp.

ARARÍBA

Family: Rubiaceae

Other Common Names: Guayatil colorado, Palo colorado (Panama), Brasilete, Carmesí (Colombia), Aguacatire, Paraguatá (Venezuela), Palo rosado (Peru), Arareua, Arariba, Pau Brasil (Brazil).

Distribution: Continental tropical America from southern Mexico to southern Brazil and Paraguay.

THE TREE Sometimes 65 ft in height with a trunk diameter of 20 in.

THE WOOD **General Characteristics:** Heartwood rather dark brown, usually poorly developed; sapwood usually becoming red, pink, or violet-rose throughout or more often variegated and often fading to yellowish-brown on the surface. Luster medium to low; texture rather fine and uniform; grain straight to irregular; odorless when dry, taste slightly bitter.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	10,800	1,200	5,030
15%	14,400	--	6,700

Janka side hardness for green material 1,070 lb.
Amsler toughness at 15% moisture content 130 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: No information available on drying characteristics. Shrinkage green to ovendry: radial 2.8%; tangential 8.2%; volumetric 10.6%.

Working Properties: Working properties are reported as good.

Durability: Based on a laboratory evaluation, reported to have moderate resistance to attack by decay fungi.

Preservation: Reported to be highly permeable.

Uses: Turnery, boxes and crates, interior trim, millwork, light construction. Wood and bark yield a red dye used commercially.

ADDITIONAL READING

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1971. Arariba - *Sickingia* sp. - Rubiaceae.
Fichas de Características das Madeiras Brasileiras,
Instituto de Pesquisas Tecnológicas, São Paulo No. 1
PT/DIMAD/PC:24.
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1949. Timbers of the new world. Yale University Press.
New Haven, Conn.

SIMAROUBA AMARA

SIMAROUBA
MARUPA

Family: Simaroubaceae

Other Common Names: Aceituno (Honduras, Nicaragua, Panama), Cedro blanco, Simaruba (Venezuela), Soemaroeba (Surinam), Caixeta, Marupá, Marubá (Brazil), Acajou blanc (Fr. Guiana).

Distribution: Northern South America from Venezuela and the Guianas to the Amazon region of Brazil, also in Trinidad and Tobago.

THE TREE A large unbuttressed tree reaching a height of 140 ft and diameters of 20 to 24 in., occasionally 36 in. Boles are straight, cylindrical, strongly tapered, frequently clear to 70 to 90 ft.

THE WOOD **General Characteristics:** Heartwood not differentiated from the whitish or straw-colored sapwood, with occasional oily streaks. Luster rather high; texture medium and uniform; grain usually straight; without odor but with a bitter quinine-like taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.38; air-dry density 27 pcf.

Mechanical Properties: (First set of data based on 2-in. standard, second set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	6,310	1,140	2,970
12%	8,930	1,240	4,840
12% (<u>1</u>)	8,350	1,290	4,900

Janka side hardness 390 lb for green material and 440 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material 66 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be easy to air season, boards dry rapidly with little or no degrade. No information on kiln schedules available. Shrinkage from green to ovendry: radial 2.3%; tangential 5.0%; volumetric 8.0%.

Working Properties: The wood works easily and machines to a smooth clean surface. Freshly felled logs tend to split in sawing due to internal stresses. The wood is easy to finish and to glue.

Durability: Pure culture tests indicate the wood to be somewhat durable to a white-rot and brown-rot fungus; however, actual graveyard evaluations show the wood to be readily attacked by decay fungi and insects. The wood is also very susceptible to dry-wood termite attack and prone to blue stain.

Preservation: Absorption and penetration of wood preservatives are excellent using either a pressure-vacuum system or open tank methods.

Uses: Interior construction, boxes and crates, furniture components, veneer and plywood, patternmaking, millwork, particle- and fiberboard.

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del área del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
3. Vink, A. T.
1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam. Surinam Forest Service, Paramaribo.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

SPONDIAS MOMBIN

JOBÓ

HOG PLUM

Family: Anacardiaceae

Other Common Names: Balá (Costa Rica), Jobito (Panama), Jobo blanco (Colombia), Jobo corronchoso (Venezuela), Hoeboe (Surinam), Acaiba, Cajá, Pau da tapera (Brazil), Ubo (Peru), Hobo (Mexico).

Distribution: Throughout most of the West Indies and from southern Mexico to Peru and Brazil; in part cultivated or naturalized. The tree is planted in many tropical areas.

THE TREE The tree is up to 130 ft in height with diameters to 48 in. Boles with basal swelling, at times coarsely furrowed, clear 60 to 80 ft.

THE WOOD General Characteristics: Heartwood cream to buff colored not distinguished from the sapwood. Luster medium; texture medium to coarse; grain straight to slightly irregular; odorless and tasteless.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40; air-dry density 29pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	6,400	1,160	2,560
12%	8,810	1,280	4,410
12% (2)	8,050	1,330	--
12% (1)	9,500	--	6,450

Janka side hardness at 12% moisture content ranges from 335 to 510 lb. Forest Products Laboratory toughness average for green and dry material is 74 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air dries rapidly but develops moderate warp and slight checking. No data are available on kiln schedules. Shrinkage green to ovendry: radial 2.7%; tangential 4.7%; volumetric 7.5%.

Working Properties: The wood is easy to work and generally finishes smoothly; fuzzy grain may develop in some operations.

Durability: The wood has low resistance to attack by decay fungi and insects and is particularly prone to blue stain. Logs need to be promptly processed to minimize deterioration.

Preservation: Deep penetration and high chemical absorption are easily obtained using either a pressure-vacuum or open tank system.

Uses: Boxes and crates, general carpentry, millwork, utility plywood, furniture components; often planted as "live fencing."

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

STERCULIA APETALA

CHICHA

Family: Sterculiaceae

Other Common Names: Anacagüita (Puerto Rico), Bellota, Chiapas (Mexico), Panamá (Panama), Sunsún (Venezuela), Camajurú (Colombia).

Distribution: Southern Mexico and Central America to Peru and Brazil. Widely planted elsewhere in the tropics as a shade tree, for the edible seeds, and as a honey plant.

THE TREE May reach a height of 130 ft and a trunk diameter of 80 in.; develops prominent, narrow buttresses.

THE WOOD General Characteristics: Heartwood light brown, reddish-brown, or yellowish-brown, not sharply demarcated from the yellowish sapwood. Luster medium; texture medium; grain straight to irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.33; air-dry density 25pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	4,460	980	2,140
12% (<u>1</u>)	7,110	960	4,230
12% (<u>2</u>)	4,900	965	--
12% (<u>1</u>)	5,900	--	3,680

Janka side hardness at 12% moisture content ranges from 270 to 530 lb. Forest Products Laboratory toughness average for green and dry material 48 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to air dry well if dried slowly; prone to collapse. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.7%; tangential 8.3%; volumetric 11.8%.

Working Properties: Generally reported to be easy to work with both hand and machine tools; timber from Panama showed considerable fuzzy grain after planing.

Durability: No resistance to attack by decay fungi or insects, also prone to blue stain.

Preservation: One report describes this wood as very easy to treat obtaining high absorption and deep and uniform penetration, another rates this wood as moderately difficult.

Uses: Boxes and crates, interior construction, plywood, particleboard, millwork.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
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1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
3. Wangaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

STERCULIA PRURIENS

STERCULIA

Family: Sterculiaceae

Other Common Names: Yahu, Maho, Manmaho (Guyana), Chicha brava, Capote, Envireira (Brazil).

Distribution: Occurs in the Guianas and northern Brazil.

THE TREE Sometimes reaches a height of 130 ft and trunk diameters of 36 in.; more commonly 100 ft in height with diameters around 24 in. Boles are clear to 60 to 70 ft with low taper.

THE WOOD General Characteristics: Heartwood whitish or grayish and not distinct from the sapwood. Texture medium to coarse; grain usually straight; somewhat lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.46; air-dry density 37 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, second on the 2-cm standard, third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	9,000	1,890	4,350
12% (<u>3</u>)	9,700	1,930	8,230
12% (<u>1</u>)	12,400	1,605	7,100
	12,600	1,780	6,550

Janka side hardness at 12% moisture content ranges from 770 to 825 lb. Forest Products Laboratory toughness at 12% moisture content 116 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be moderately difficult to air season; dries rapidly but tends to warp. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to oven-dry: radial 4.7%; tangential 9.9%; volumetric 15.4%. Movement after manufacture is rated as large.

Working Properties: The wood works easily with both hand and machine tools; a smooth finish is obtained if sharp cutters are used.

Durability: Not resistant to attack by decay fungi and very susceptible to both dry-wood and subterranean termites. Also prone to blue stain.

Preservation: Reported to be moderately resistant to penetration using creosote oils.

Uses: Light construction work, interior joinery, boxes and crates, pulp and paper.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del área del proyecto. FAO Report FAO/SF: 82 VEN 5. Rome.
2. Kynoch, U., and N. A. Norton.
1938. Mechanical properties of certain tropical woods, chiefly from South America. Univ. of Mich. School of Forestry and Conservation Bull. No. 7.
3. Lavers, G. M.
1967. The strength properties of timbers. Forest Products Research Bull. No. 50. H. M. Stationery Office. London.
4. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.

SWARTZIA spp.

WAMARA
BANNIA

Family: Leguminosae

Other Common Names: Naranjillo (Mexico, Honduras, Panama), Parakusan (Guyana), Gandoe, Ijzerhart (Surinam), Alma negra (Colombia), Orura barrialera (Venezuela), Icoje (Peru), Pau ferro, Mututy (Brazil).

Distribution: Southern Mexico, through Central America, the West Indies and southward to northern South America; especially abundant in the Guianas and the Amazon region.

THE TREE Size varies considerably with species, some reaching heights of 110 ft with trunk diameters commonly to 24 in., but reaching 36 in.

THE WOOD General Characteristics: Heartwood dark brown, reddish-brown, or nearly black, in solid color or somewhat variegated; sharply demarcated from the nearly white to yellowish sapwood. Texture very fine to medium; luster usually medium; grain straight to irregular; without distinctive odor or taste. Dust irritating to some workers.

Weight: Basic specific gravity (ovendry weight/green volume) 0.87-1.02; air-dry density 65 to 75 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard, the second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	22,870	3,000	12,930
12%	26,370	3,630	15,440
Green (<u>2</u>)	21,400	2,480	10,500
12%	32,600	3,220	16,500
15% (<u>1</u>)	23,460	2,620	12,900

Janka side hardness 3,325 to 4,060 lb for dry material. Forest Products Laboratory toughness average for green and dry material is 260 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to be moderately difficult to air dry because of checking and warp. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 3.9%; tangential 7.6%; volumetric 11.2%. Movement after manufacture of some species is reported high.

Working Properties: The woods are difficult to work because of their high density, but finishes very smoothly and takes a high polish. Workers should be protected from the irritating dust of some species (S. bannia).

Durability: Heartwood is very resistant to attack by decay fungi and resistant to dry-wood termites. Not resistant to marine borers.

Preservation: No information available.

Uses: Inlay, parquet flooring, turnery, furniture, cabinet-work, violin bows, specialty items, suggested as a substitute for ebony.

ADDITIONAL READING

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1957. [Tests about the most important mechanical and physical properties of 41 Surinam wood species.]
Royal Tropical Institute. Afdeling Tropische Producten No. 46.
2. Lavers, G. M.
1967. The strength properties of timbers. Forest Products Research Bull. No. 50. H. M. Stationery Office. London.
3. Longwood, F. R.
1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture, p. 167.
4. Wanggaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V. Tropical Woods No. 103:1-139.

SWIETENIA MACROPHYLLA

HONDURAS MAHOGANY

CAOBA

Family: Meliaceae

Other Common Names: Caoba (throughout Latin America), Acajou (French-speaking areas).

Distribution: Southern Mexico southward to Colombia, Venezuela, and parts of the upper Amazon and its tributaries in Peru, Bolivia, and Brazil. Plantations have been established within its natural range and elsewhere.

THE TREE Sometimes 150 ft in height and 6 ft and more in diameter above the heavy buttresses; boles are clear from 60 to 80 ft.

THE WOOD **General Characteristics:** Heartwood reddish, pinkish, salmon-colored, or yellowish when fresh; deepening with age to deep rich red or brown; distinct from the yellowish or whitish sapwood. Luster high and golden; texture rather fine to coarse; grain straight to roey, wavy, or curly, often with an attractive figure; odor and taste not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40 to 0.68; air-dry density 30 to 52 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	<u>Psi</u>	<u>1,000 psi</u>	<u>Psi</u>
Green (<u>4</u>)* 12%	8,960 11,590	1,280 1,420	4,340 6,470
Green (<u>4</u>) 12%	8,960 11,460	1,340 1,500	4,340 6,780
12% (<u>1</u>)	12,000	1,270	6,400

Janka side hardness 740 lb for green material and 800 lb for dry. Forest Products Laboratory toughness average for green and dry material 82 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood can be air seasoned and kiln dried easily without appreciable warping or checking. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.0%; tangential 4.1%; volumetric 7.8%. Movement after manufacture is rated as small.

Working Properties: Very easy to work with hand and machine tools, torn and chipped grain is common with figured material. Easy to finish and takes an excellent polish. Slices and rotary cuts into fine veneer.

Durability: Generally heartwood rates as durable in resistance to a brown-rot and a white-rot fungus. Moderately resistant to dry-wood termites and little resistance to attack by marine borers.

Preservation: Both heartwood and sapwood are resistant to impregnation with preservatives.

Uses: Fine furniture and cabinetmaking, interior trim, paneling, fancy veneers, musical instruments, boat building, patternmaking, turnery, and carving.

ADDITIONAL READING

1. Lavers, G. M.
1967. The strength properties of timbers. Forest Products Research Bull. No. 50. H. M. Stationery Office. London.
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3. Record, S. J., and R. W. Hess.
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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

SYMPHONIA GLOBULIFERA

MANNI
CHEWSTICK

Family: Guttiferae

Other Common Names: Barillo (Guatemala, Honduras), Cerillo (Costa Rica, Panama), Machare (Colombia), Mani, Paramán (Venezuela), Mataki (Surinam), Manni (Guyana), Anany (Brazil), Brea-caspi (Peru).

Distribution: West Indies, Central America, and northern South America, also occurs in tropical West Africa. The trees are most abundant and reach their best development in swamp and marsh areas.

THE TREE Frequently 100 ft in height with trunk diameters of 20 to 30 in.; exceptional specimens are 135 ft tall with diameters over 40 in. Stems develop stiltroots with numerous elbow buttresses.

THE WOOD General Characteristics: Heartwood yellowish-, grayish-, or greenish-brown or striped in these shades; distinct from the whitish sapwood. Luster somewhat medium, variable; texture coarse; grain straight to irregular; without distinctive odor or taste; has a mealy appearance because of the abundant soft parenchyma tissue. Silica reported to range up to 0.21%.

Weight: Basic specific gravity (ovendry weight/green volume) 0.58; air-dry density 44 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard, the second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)* 12%	11,180 16,860	1,960 2,460	5,160 8,820
Green (<u>1</u>) 12%	12,450 19,000	1,890 2,060	6,040 9,650
12% (<u>2</u>)	16,500	2,360	--

Janka side hardness for green material 940 lb, 1,120 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 157 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to air season rapidly but with moderate warping and checking. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage from green to oven-dry: radial 5.7%; tangential 9.7%; volumetric 15.6%.

Working Properties: Very easy to work with both hand and machine tools, but surfaces tend to roughen in planing and shaping.

Durability: Heartwood is durable in ground contact; only moderately resistant to dry-wood and subterranean termites.

Preservation: The wood is rated as resistant to impregnation.

Uses: Railroad crossties, general construction, cooperage, furniture components, flooring, utility plywood, suggested as an oak substitute. The bark contains a yellowish resin that is medicinal, used to caulk boats, and as a substitute for shoemaker's pitch.

ADDITIONAL READING

1. Lavers, G. M.
1967. The strength properties of timbers. Forest Products research Bull. No. 50. H. M. Stationery Office. London.
2. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
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1962. Present and potential commercial timbers of the Caribbean. Agriculture Handbook No. 207. U.S. Department of Agriculture.
4. Wangaard, F. F., W. L. Stern, and S. L. Goodrich.
1955. Properties and uses of tropical woods, V. Trop. Woods No. 103:1-139.

TABEBUIA spp. (LAPACHO GROUP)

IPE
BETHABARA
LAPACHO

Family: Bignoniaceae

Other Common Names: Amapa (Mexico), Cortez (Honduras, Nicaragua, Costa Rica), Guayacán (Panama), Guayacan polvillo (Colombia), Flor Amarillo (Venezuela), Greenhart (Surinam), Madera negra (Ecuador), Tahuari (Peru), Ipê (Brazil), Lapacho negro (Paraguay, Argentina).

Distribution: Throughout continental tropical America and some of the Lesser Antilles. The tree grows on a variety of sites, from ridge tops to riverbanks and marsh forests.

THE TREE May grow to 140 to 150 ft in height with trunk diameters of 6 ft. Frequently to heights of 100 ft and diameters of 2 to 3 ft. Boles are clear to 60 ft and more, with or without buttresses.

THE WOOD **General Characteristics:** Heartwood olive-brown to blackish, often with lighter or darker striping, often covered with a yellow powder; sharply demarcated from the whitish or yellowish sapwood. Texture fine to medium; luster low to medium; grain straight to very irregular; rather oily-looking; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.85-0.97; air-dry density 66 to 75 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard, the second on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	22,560	2,920	10,350
12% (<u>1</u>)	25,360	3,140	13,010
12% (<u>1</u>)	25,200	3,010	14,000
12% (<u>2</u>)	28,000	3,350	--

Janka side hardness 3,060 lb for green material and 3,680 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 404 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to air dry rapidly with only slight checking and warping. Kiln schedule T3-Cl is suggested for 4/4 stock. Shrinkage green to ovendry: radial 6.6%; tangential 8.0%; volumetric 13.2%. Movement after manufacture is rated as small.

Working Properties: Moderately difficult to work especially with handtools; has a blunting effect on cutting edges, finishes smoothly except where grain is very roey. The fine yellow dust produced in most operations may cause dermatitis in some workers.

Durability: Heartwood is very resistant to attack by decay fungi and termites; not resistant to marine borers. T. guayacan, however, is reported to have good resistance in Panama waters.

Preservation: The wood is reported to be extremely resistant to preservation treatments.

Uses: Railroad crossties, heavy construction, tool handles, turnery, industrial flooring, textile mill items, decorative veneers.

ADDITIONAL READING

1. FAO.
1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SF: 82 VEN 5.
2. Llach C., L.
1971. Properties and uses of 113 timber-yielding species of Panama. Part 3. Physical and mechanical properties of 113 tree species. FO-UNDP/SF PAN/6. FAO. Rome.
3. Longwood, F. R.
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1954. Properties and uses of tropical woods, IV. Tropical Woods No. 99:1-187.

TABEBUIA spp. (ROBLE GROUP)

ROBLE
MAYFLOWER

Family: Bignoniaceae

Other Common Names: Roble (Spanish America), Amapa, Roble blanco (Mexico), Roble blanco, Roble de sabana (Costa Rica), Roble del rio (Colombia), Apamate (Venezuela).

Distribution: From the West Indies and southern Mexico to Venezuela and Ecuador. Inhabits various sites from wet lowlands to dry mountain sides.

THE TREE A medium-sized tree 40 to 60 ft high, but occasionally reaching a height of 90 ft; diameters commonly 18 to 24 in., sometimes reaching 36 in.; buttresses often extend 7 to 10 ft above the ground; widely planted as an ornamental.

THE WOOD General Characteristics: Heartwood light brown to golden; not clearly differentiated from the sapwood. Luster low to medium; texture medium to rather coarse; grain straight to roey; without distinctive odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	10,770	1,450	4,910
12%	13,780	1,600	7,340
Green (1)	9,600	1,620	5,030
12%	12,500	1,750	6,010
12% (2)	14,700	--	7,050

Janka side hardness for green wood 910 lb, 960 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material is 147 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood air seasons and kiln dries rapidly with little or no checking and warping. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage from green to ovendry: radial 3.6%; tangential 6.1%; volumetric 9.5%.

Working Properties: The wood has excellent machining characteristics but some care is required in planing to prevent torn and chipped grain. Finishes well, easy to glue. With care, cuts well into sliced veneer.

Durability: Both pure culture tests and field evaluations indicate the wood to be moderately durable to very durable; reported to be very susceptible to dry-wood termite attack and little resistance to marine borers.

Preservation: Penetration and absorption of preservative solutions are low, even in the sapwood. This may be improved somewhat by incising.

Uses: Flooring, furniture, cabinetwork, interior trim, tool handles, decorative veneers, boat building. For some applications suggested as a substitute for ash and oak.

ADDITIONAL READING

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1938. Mechanical properties of certain tropical woods,
chiefly from South America. Univ. of Mich. School of
Forestry and Conservation Bull. No. 7.
2. Laboratorio Nacional de Productos Forestales.
1974. Caracteristicas, propiedades, y usos de
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Universidad de Los Andes, Merida.
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1962. Present and potential commercial timbers of the
Caribbean. Agriculture Handbook No. 207. U.S.
Department of Agriculture.
4. Wangaard, F. F., and A. F. Muschler.
1952. Properties and uses of tropical woods, III.
Trop. Woods No. 98:1-190.

TABELUIA spp. (WHITE-CEDAR GROUP)

WHITE-CEDAR
WHITE TABEBUIA

Family: Bignoniaceae

Other Common Names: White-cedar, Warakuri (Guyana), Zwamp panta (Surinam), Bois blanchet, Cèdre blanc (French Guiana).

Distribution: The Guiana Region and Brazil.

THE TREE Trees are commonly 90 ft high and about 12 in. in diameter but occasionally up to 16 in. Fluted buttresses range up to 12 ft in height (T. insignis). T. stenocalyx is a larger tree growing to a height of 150 ft with trunk diameters to 3 ft.

THE WOOD General Characteristics: Heartwood brownish with reddish or olive hue, also creamy or yellowish, varying in different specimens; not sharply demarcated from the sapwood. Luster rather high; texture medium and uniform; grain fairly straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 42pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, the second set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2) 12%	13,700 14,900	2,300 2,260	6,200 8,240
12% (1)	18,600	2,040	9,340

Janka side hardness for dry material 1,160 to 1,400 lb. Forest Products Laboratory toughness at 12% moisture content 126 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be easy to air season. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.7%; tangential 7.2%; volumetric 10.8%.

Working Properties: Dry lumber machines easily with smooth clean surfaces in all operations. Green logs are reported to spring badly in sawing.

Durability: The wood does not have decay resistance and is vulnerable to termite attack.

Preservation: Both sapwood and heartwood are reported to have good absorption and penetration of preservatives using either a pressure-vacuum or open tank system.

Uses: Tool handles, furniture, flooring, interior trim, general carpentry, boxes, and crates. Suggested as a possible substitute for ash and birch.

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4. Vink, A. T.
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TERMINALIA AMAZONIA
SYN. T. OBOVATA

NARGUSTA

Family: Combretaceae

Other Common Names: Almendro (Honduras), Canshán (Mexico), Amarillo carabazuelo (Panama), Guayabo león (Colombia), Pardillo negro (Venezuela), Pau-mulato brancho (Brazil).

Distribution: Southern Mexico southward through Central America and into northern South America to Brazil and Peru; also Trinidad. The tree is common in the Wallaba forests of Guyana. Concentrations of four to five trees per acre are not unusual in Belize.

THE TREE May reach a height of 140 ft with diameters of 4 to 5 ft. Trees with diameters over 20 to 25 in. are often hollow. Long, clear, symmetrical boles are 60 to 70 ft long above the large buttresses.

THE WOOD General Characteristics: Heartwood variable from yellowish-olive to golden-brown, sometimes with prominent reddish-brown stripes; not readily separated from the yellowish sapwood. Luster medium to rather high; texture medium; grain roey; without distinctive odor or taste in dry material.

Weight: Basic specific gravity (ovendry weight/green volume) 0.58-0.73; air-dry density 44 to 56 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, the second on the 2-cm standard, and the third on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
		Psi	1,000 psi
Green (<u>4</u>)* 12%	12,130 17,750	2,010 2,300	5,530 9,540
Green (<u>2</u>) 12%	13,600 19,100	1,890 2,130	6,700 10,350
12% (<u>1</u>)	25,200	2,910	11,600

Janka side hardness at 12% moisture content 1,610 to 2,100 lb. Forest Products Laboratory toughness average for green and dry material is 187 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Very variable in seasoning characteristics; some material reported easy to dry with little or no degrade; other material dried with difficulty and with considerable warp and checking. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 6.4%; tangential 8.7%; volumetric 14.9%.

Working Properties: Generally reported to be somewhat fair to difficult to work with hand and machine tools; straight-grained material planes well, some tearing occurs on strongly roey surfaces.

Durability: Pure culture tests showed the wood to be durable to both a white-rot and brown-rot fungus. Results of graveyard tests indicate considerable variability from very durable to only slight or fair resistance. Reported to be resistant to dry-wood termites but not to subterranean termites.

Preservation: Heartwood is extremely resistant to preservation treatments, treatability of sapwood is variable.

Uses: Flooring, railroad crossties, furniture and cabinet work, shipbuilding, turnery, general construction, utility plywood. It is suggested as a possible substitute for oak.

ADDITIONAL READING

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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

TETRAGASTRIS SPP.

SALI
MASA

Family: Burseraceae

Other Common Names: Masa, Palo de aceite (Puerto Rico), Kerosén (Nicaragua), Palo de cerdo, Aguarrás (Colombia), Haiawaballi (Guyana), Gommier, Encens rouge (French Guiana), Almesca (Brazil).

Distribution: West Indies, Central America, and northern South America. Widely distributed and locally frequent in the high forests of Surinam.

THE TREE Varies with species but may reach a height of 100 ft with diameters up to 28 in. Boles with a few buttresses, of moderately good form, and clear for 30 to 40 ft.

THE WOOD **General Characteristics:** Heartwood orange-brown; rather sharply demarcated from the yellowish-brown sapwood. Luster medium to rather high; texture fine; grain mostly irregular to distinctly roey; without distinctive taste, but with fragrant balsamic scent. A silica content of 0.13% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.63 to 0.78; air-dry density 48 to 61 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)	12,380	1,650	5,460
12%	16,090	1,890	8,380
Green (<u>2</u>)	12,300	1,940	6,800
12%	15,200	2,180	8,300
12% (<u>1</u>)	19,400	2,410	10,200

Janka side hardness at 12% moisture content 1,770 to 2,170 lb. Forest Products Laboratory toughness average for green and dry material 223 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasoning properties vary with species from rapid drying with little or no degrade to rather slow drying with a tendency to check and split. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.4%; tangential 8.5%; volumetric 13.9%.

Working Properties: Reported to be moderately difficult to moderately easy to machine, varying with species. Steam-bending characteristics are fair to good.

Durability: Heartwood is rated durable to very durable in its resistance to both brown-rot and white-rot fungi, but only somewhat resistant to attack by dry-wood termites.

Preservation: Heartwood is highly resistant to preservation treatments; however sapwood is reported as responsive.

Uses: Heavy construction, flooring, furniture, interior trim, slack cooperage, railroad crossties. Suggested as a substitute for birch and maple.

ADDITIONAL READING

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TRIPLARIS spp.

LONG JOHN
MIERENHOUT

Family: Polygonaceae

Other Common Names: Palo mulato (Mexico), Hormigo (Costa Rica), Palo hormiguero (Panama), Palo santo (Colombia), Vara de maria (Venezuela), Mierenhout (Surinam), Long John (Guyana), Tangarana (Peru), Formigueira (Brazil).

Distribution: Southern Mexico, through Central America, and tropical South America. In Surinam the tree is dominant in swamps and frequent on low riverbanks. Sometimes forming almost pure stands on abandoned clearings.

THE TREE A medium-sized tree, becoming 70 ft tall and 18 in. in diameter; the bole is slightly angled or fluted and has low narrow buttresses. Hollow stems are inhabited by small vicious ants which emerge quickly and attack anyone molesting the tree.

THE WOOD General Characteristics: Sapwood not distinct from heartwood which is a pale gray-brown to pinkish-brown. Luster medium; texture medium to moderately coarse; grain straight or slightly interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.50 to 0.62; air-dry density 38 to 48 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, second and third sets on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
15% (<u>2</u>)*	13,230	1,880	7,040
12% (<u>1</u>)	15,000	2,020	8,000
12% (<u>3</u>)	18,300	--	8,100

Janka side hardness at 12% moisture content 1,040 to 1,820 lb. Forest Products Laboratory toughness for dry material varied from 121 to 186 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Drying reported to vary from fairly slow to rapid, depending on species, with medium warping and checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.5%; tangential 8.6%; volumetric 12.3%.

Working Properties: Machines well in all operations, but rated only fair in turning.

Durability: Not resistant to attack by decay fungi and vulnerable to dry-wood termites.

Preservation: Tests in Venezuela show this wood to be difficult to treat with preservatives.

Uses: Furniture components, boxes and crates, interior construction, fiberboard and particleboard, joinery.

ADDITIONAL READING

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2. Japing, H. W.
1957. [Tests about the most important mechanical and physical properties of 41 Surinam wood species.] Royal tropical Institute, Afdeling Tropische Producten No. 46.
3. Laboratorio Nacional de Productos Forestales.
1974. Caracteristicas, propiedades, y usos de 104 maderas de los altos llanos occidental. Universidad de Los Andes, Merida.

TROPHIS spp.

RAMÓN
MORILLO

Family: Moraceae

Other Common Names: Ramón de Castilla (Mexico), San Ramón (Honduras), Gallote, Morillo (Panama), Guáimaro (Colombia), Charo negro, Marfil (Venezuela), Cuchara-caspi (Peru).

Distribution: Throughout the West Indies, southern Mexico, Central America, and the Andean region of South America into Peru.

THE TREE A medium-sized tree 70 ft high with a trunk diameter of 18 in.

THE WOOD General Characteristics: Heartwood light to dark brown with parenchyma markings suggesting elm; sharply demarcated with the creamy to yellowish sapwood. Fairly lustrous; texture medium; grain straight to irregular; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.42 to 0.65; air-dry density 31 to 50 pcf.

Mechanical Properties: (1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	11,200	--	6,000

Janka side hardness at 12% moisture content 770 lb. Forest Products Laboratory toughness at the same moisture content 96 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to air-dry rapidly. No data available on kiln schedules or shrinkage properties.

Working Properties: Reports vary from very abrasive and difficult to work to machines without difficulty and finishes smoothly.

Durability: Graveyard tests in Venezuela indicate the wood to be very susceptible to attack by decay fungi and insects.

Preservation: High chemical absorptions for both heartwood and sapwood are reported using either a pressure-vacuum or open tank system, penetrations were vascular.

Uses: Suggested as a veneer for plywood and scaffolding in Venezuela.

ADDITIONAL READING

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1974. Caracteristicas, propiedades, y usos de 104 maderas de los altos llanos occidental. Universidad de Los Andes, Merida.
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VATAIREA spp.

BITTER ANGELIM
FAVEIRA

Family: Leguminosae

Other Common Names: Amargoso (Honduras), Amargo amargo (Panama), Arisauru, Yaksaru (Guyana), Mora (Nicaragua), Gele Kabbes (Surinam), Angelim, Faveira (Brazil).

Distribution: Southern Mexico, southward along the Atlantic region of Central America, and through Venezuela to the Rio de Janeiro region of Brazil.

THE TREE Sometimes to a height of 125 ft with trunk diameters to 6 ft, commonly to 3 ft, boles have narrow high buttresses and may be clear for 70 ft.

THE WOOD General Characteristics: Heartwood yellow, becoming orange-brown on exposure, striped with parenchyma, sometimes with oily appearance; distinct from the whitish, grayish, or brownish-yellow sapwood. Luster variable; texture coarse to very coarse; grain straight to strongly interlocked; without distinctive odor but with bitter taste. Silica content of 0.2% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.55 to 0.64; air-dry density 42 to 49 pcf.

Mechanical Properties: (2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
Green (<u>1</u>)	10,300	1,700	5,020
12% (<u>3</u>)	14,600	1,790	6,950
15% (<u>2</u>)	17,200	2,340	--

Janka side hardness for dry material 1,080 to 1,420 lb.

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is reported to have a moderate air-drying rate with little or no drying defects. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.4%; tangential 7.4%; volumetric 8.6%.

Working Properties: Generally reported to be moderately good in machining characteristics but torn and raised grain in planing is common. Fine dust raised during working affects some operators.

Durability: Heartwood is rated as moderately durable to durable based on graveyard tests.

Preservation: Heartwood is reported to be very difficult to preserve, treatment of sapwood is good.

Uses: Construction work, flooring, general carpentry, railroad crossties.

ADDITIONAL READING

1. FAO.
1973. Investigacion sobre el fomento de la produccion de los bosques del noreste de Nicaragua: propiedades y usos de quince especies maderables del noreste de Nicaragua. FAO report FO: SF/NIC 9, Informe técnico 8, Nicaragua.
2. Japing, H. W.
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VIROLA SPP.

BANAK

BABOEN

Family: Myristicaceae

Other Common Names: Sangre, Palo de sangre (Guatemala, Honduras), Sangredrago (Nicaragua), Fruta dorada (Costa Rica), Miguelarillo (Panama), Sangre de toro (Colombia), Camaticaro (Venezuela), Baboen (Surinam), Bicuiba (Brazil), Cumala (Peru).

Distribution: Varying with species from Belize and Guatemala southward to Venezuela, the Guianas, the Amazon region of northern Brazil, southern Brazil, and on the Pacific Coast, to Peru and Bolivia; common in swamp and marsh forests.

THE TREE May reach a height of 140 ft with trunk diameters of 5 ft, usually much shorter and only 2 to 3 ft in diameter. Boles are heavily buttressed, cylindrical, and clear for more than two-thirds of total height.

THE WOOD **General Characteristics:** On drying and exposure, heartwood becomes a pinkish golden-brown or deep reddish-brown; sapwood cream to tan color, not always sharply demarcated. Luster low to medium; texture rather coarse; grain straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies considerably with species from about 0.36 to 0.61, commonly 0.44; air-dry density 27 to 46 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, the second set on the 2-cm standard, and the third set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	5,600	1,640	2,390
12%	10,950	2,040	5,140
Green (<u>2</u>)	6,520	1,380	3,180
12%	11,450	1,610	5,950
12% (<u>1</u>)	7,780	1,280	4,740

Janka side hardness for dry material 450 to 640 lb.
Forest Products Laboratory toughness average for
green and dry material 61 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to be difficult to season with a strong tendency to warp and check as well as collapse and honeycomb; thick stock slow to dry. Kiln schedule T3-C2 suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.6%; tangential 8.8%; volumetric 13.7%.

Working Properties: Works easily with both hand and machine tools and produces a good finish, glues well; cuts well into veneers.

Durability: The wood is not resistant to attack by decay fungi and is very susceptible to attack by termites and other insects. Logs require prompt conversion or water storage to prevent damage by pinhole borers. Bacterial attack resulting in the formation of odoriferous compounds is also reported.

Preservation: The timber is reported to be easily impregnated with preservatives using either pressure-vacuum or open tank systems.

Uses: Veneer and plywood, particle and fiberboard, furniture components, boxes and crates, light construction, general carpentry, millwork. Oil is extracted from seeds of Virola and used in soaps and candles.

ADDITIONAL READING

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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

VITEX SPP.

FIDDLEWOOD
ACEITUNO

Family: Verbenaceae

Other Common Names: Negrito coyote (Mexico), Barbás, Rajate bién (Guatemala, Honduras), Cuajado (Panama), Aceituno (Colombia, Venezuela), Perchiche (Ecuador), Tahuari (Peru), Tarumá cheiroso (Brazil).

Distribution: Throughout tropical America from Mexico and the West Indies southward to Argentina and Uruguay.

THE TREE Size varies with species but may reach a height of 75 to 100 ft with trunk diameters of 24 to 36 in.

THE WOOD General Characteristics: Heartwood variable with species; yellowish-brown, deep brown, olive-green, or olive-brown; usually not sharply demarcated from the whitish, yellow, or pale brown sapwood. Luster low to high; texture rather fine to moderately coarse; grain straight, sometimes irregular; without distinctive odor or taste. A silica content of 0.76% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52 to 0.60; air-dry density 40 to 46 pcf.

Mechanical Properties: (First and third sets of data based on the 2-in. standard, the second set on the 1-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)* 12%	9,420 12,890	1,490 1,570	4,780 7,010
12% (<u>1</u>)	17,700	2,400	10,900
12% (<u>3</u>)	16,600	2,040	--

Janka side hardness at 12% moisture content 1,160 lb. Forest Products Laboratory toughness average for green and dry material 108 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reports are variable, material from Panama had a moderate drying rate and no appreciable defects; V. gaumeri from Belize is somewhat difficult to season with a moderate amount of crook and checking. No data available on kiln schedules. Shrinkage from green to ovendry: radial 3.2%; tangential 6.4%; volumetric 10.4%.

Working Properties: Easy to work with both hand and machine tools though there is some tearing if grain is irregular; takes a high polish; V. cooperi splits readily while V. gaumeri is very difficult to split.

Durability: Depending on species varied from moderately durable to very durable when exposed to a white-rot and brown-rot fungus. Actual field exposures show some species as durable and others as susceptible to attack by decay fungi and insects.

Preservation: Heartwood is not treatable, sapwood has good absorption and penetration of preservatives using either a pressure vacuum or open tank system.

Uses: Furniture, millwork, veneer and plywood, general carpentry, mallet heads, chisel handles (V. gaumeri), flooring.

ADDITIONAL READING

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1970. Estudio de preinversion para el desarrollo forestal de la Guyana Venezolana. Informe final. Tomo III. Las maderas del area del proyecto. FAO Report FAO/SL: 82 VEN 5. Rome.
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VOCHYSIA SPP.

YEMERI
QUARUBA

Family: Vochysiaceae

Other Common Names: Corpus (Mexico), Yemeri (Belize, Nicaragua), Corosillo (Panama), Dormilon (Colombia), Tin-tin (Venezuela), Kwari (Surinam), Kouali (French Guiana), Chambo caspi (Peru), Quaruba (Brazil).

Distribution: Throughout tropical America from southern Mexico to Peru but most abundant in the Guianas and Brazil. The trees make their best growth on coastal plains and along waterways, forms almost pure stands on abandoned farms.

THE TREE Varies with species, commonly 100 ft in height with diameters of 24 in.; however trees to a height of 190 ft and diameters up to 6 ft are reported. Boles are sometimes basally swollen or buttressed, cylindrical, and clear.

THE WOOD General Characteristics: Heartwood a dull uniform pink, pinkish-brown or golden-brown; not always sharply demarcated from the whitish to yellowish sapwood. Luster medium to high; texture is moderately coarse; grain slightly to highly interlocked; without distinctive odor or taste. Vertical traumatic gum ducts may occur sporadically and is sometimes considered as an objectionable defect.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.37 to 0.57, commonly close to 0.40; air-dry density ranges from 28 to 43 pcf.

Mechanical Properties: (2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	6,120	1,220	2,760
12%	9,090	1,390	5,840
Green (1)	6,300	1,250	3,000
12%	11,300	1,670	5,550

Janka side hardness at 12% moisture content ranges from 530 to 680 lb. Forest Products Laboratory toughness average for green and dry wood is 97 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air drying rates range from slow to rapid, prone to warp with some checking. Collapse occurs in thick stock. Quartersawing is suggested to minimize degrade. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 3/4. Shrinkage green to ovendry: radial 3.2%; tangential 10.8%; volumetric 13.0%.

Working Properties: The wood is easily worked by either hand or machine tools but raised and wooly grain are common defects; takes glue, paint, and nails well and polishes to a good finish. The wood has a tendency to blunt cutting edges.

Durability: Variable in decay resistance, generally reported to be susceptible to attack by fungi as well as insects.

Preservation: Both heartwood and sapwood are readily impregnated with preservatives.

Uses: Carpentry, utility plywood, furniture components, interior trim, millwork. The wood is suggested as a substitute for Cedrela.

ADDITIONAL READING

1. FAO.
1973. Investigaciones sobre el fomento de la produccion de los bosques del noreste de Nicaragua: propiedades y usos de quince especies maderables del noreste de Nicaragua. FAO FO: SF/NIC9, Informe técnico 8. Nicaragua.
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1952. Properties and uses of tropical woods, III. Trop. Woods No. 98:1-190.

VOUACAPOUA AMERICANA

WACAPOU
ACAPU

Family: Leguminosae

Other Common Names: Bruinhart (Surinam), Sarabebeballi (Guyana), Wacapou (French Guiana), Acapú (Brazil).

Distribution: Surinam, French Guiana, and the State of Para in Brazil. Occupies noninundated lands in upland forests.

THE TREE A canopy tree with small buttresses and usually a somewhat fluted lower trunk; boles clear to 50 to 75 ft; mostly not more than 24 in. in diameter but at times reaching 36 in.

THE WOOD General Characteristics: Heartwood dark brown or reddish-brown, deepening upon exposure, figured with fine parenchyma lines; sharply demarcated from the nearly white sapwood. Luster medium to rather low; texture uniformly coarse; grain fairly straight to irregular; dry wood has no distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.79; air-dry density 59 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	15,850	2,620	9,170
12%	21,640	2,530	11,480

Janka side hardness for green material 1,610 lb, 1,730 lb at 12% moisture content. Forest Products Laboratory toughness average for green and dry material 203 in.-lb (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Moderately difficult to dry with slight warping in the form of cup and twist and slight checking. A modified T7-B3 schedule is used in Surinam for 4/4 stock. Shrinkage from green to oven-dry: radial 4.9%; tangential 6.9%; volumetric 13.0%.

Working Properties: Moderately difficult to work because of density; machines to smooth surfaces, but there is some rough and torn grain in boring and mortising. Takes glue well.

Durability: Very durable in resistance to attack by a brown-rot and white-rot fungus, not attacked by dry-wood termites or other insects. Reports on resistance to marine borers are variable; good resistance is noted in Panama waters.

Preservation: Heartwood is highly resistant to moisture absorption and is probably not treatable.

Uses: Heavy construction, flooring (strip and parquet), interior trim, furniture, cabinetwork, paneling, railroad crossties.

ADDITIONAL READING

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1965. Surinam timbers: A summary of available information with brief descriptions of the main species of Surinam.
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1954. Properties and uses of tropical woods, IV. Trop. Woods No. 99:1-187.

ZANTHOXYLUM FLAVUM
SYN. FAGARA FLAVA

WEST INDIAN SATINWOOD

Family: Rutaceae

Other Common Names: Espinillo (Dominican Republic), Yellow sanders (Jamaica), Noyer, Bois noyer (Guadeloupe).

Distribution: Lower Florida Keys, Bermuda, Bahamas, Cuba, Jamaica, Hispaniola, Puerto Rico, and Lesser Antilles from Anguilla to St. Lucia.

THE TREE Sometimes 40 ft high with a trunk diameter up to 20 in.

THE WOOD General Characteristics: Heartwood is a creamy- or golden-yellow darkening with exposure; not clearly differentiated from the whitish to light yellow sapwood. Luster high; texture fine and even; grain interlocked or irregular often with roe or mottle figure; when freshly worked has a characteristic scent of coconut.

Weight: Basic specific gravity (ovendry weight/green volume) 0.73; air-dry density 56 pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: A closely related species in Surinam is reported to season well without difficulty; otherwise no data available on drying and shrinkage.

Working Properties: Has a moderate blunting effect on cutting edges; wood tends to ride on cutters in planing; an excellent turnery wood; takes a fine polish; dust produced in machinery operations may cause dermatitis.

Durability: The wood is reported as nondurable, but is resistant to drywood termites.

Preservation: No data available.

Uses: Cabinetmaking, fine furniture, inlays, turnery, fancy veneers, specialty items (hand mirrors and hairbrushes).

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Individual Data Sheets for

Species by Region of Origin:

Africa (AF)

AFZELIA spp.

AFZELIA

Family: Leguminosae

Other Common Names: Doussie (Cameroons), Apa, Aligna (Nigeria), Mkora, Mkola, Mbambakofi (Tanzania), Chanfuta, Mussacossa (Mozambique), Beyo, Meli, Azza (Uganda).

Distribution: West, Central, and East Africa. Occur in the dense evergreen forests, but also common in the savanna and coastal forests of East Africa.

THE TREE Reaches best development on moist sites with heights of 80-120 ft and clear boles 30-50 ft; trunk diameters 3-5 ft and more; large irregular buttresses sometimes present.

THE WOOD General Characteristics: Heartwood reddish-brown after exposure; sapwood pale straw to whitish, well defined. Texture moderate to coarse; grain straight to interlocked; medium luster; without characteristic odor or taste. Some pores contain a yellow dyestuff which, under moist conditions, can discolor textiles, paper, or other cellulosic materials.

Weight: Basic specific gravity (ovendry weight/green volume) 0.67; air-dry density 51 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	18,100	1,900	11,490
12% (4)	16,640	1,510	10,030

Janka side hardness 1,770-1,850 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons satisfactorily but slowly with little or no degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial 1.0%; tangential 1.5%. Movement in service is rated as small.

Working Properties: Rather difficult to saw and machine because of rapid dulling of saw teeth and cutters but works to a smooth finish; some tearing of grain on radial faces. Difficult to stain where pores contain yellow deposits. Classified moderate in wood bending properties. Dust may be irritating. Difficult to glue.

Durability: Heartwood is rated as very durable and moderately resistant to termite attack; sapwood liable to attack by powder-post beetles. In East African waters, teredo are slow to attack and develop. Pholad attack is more rapid.

Preservation: Extremely resistant to preservative treatments; sapwood reported to be moderately resistant.

Uses: Exterior joinery (window frames, doors), flooring, heavy construction including harbor and dock work, furniture, because of good acid resistance used for vats and tanks.

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ALBIZIA SPP.

ALBIZZIA

Family: Leguminosae

Other Common Names: Okuro (Ghana), Ayinre, Uwowe (Nigeria),
Mugavu, Nongo (Uganda), Mtanga, Mduruasi (Tanzania).

Distribution: Widely distributed throughout tropical Africa;
mostly trees of the high forest are exploited, but also
common in secondary forests.

THE TREE May reach heights of 120-150 ft with trunk diameters of 3 ft;
some species with a total height of 60 ft and a diameter
of 1.5-2.0 ft; sometimes buttressed; boles tend to be
irregular in dry areas.

THE WOOD General Characteristics: Heartwood golden yellow, light brown,
red-brown, or dark brown, sometimes with a greenish,
purple, or red tinge, sometimes with dark streaks;
sapwood whitish, yellowish, or pinkish-brown, well
demarcated. Texture variable from fine to coarse;
grain straight to interlocked or irregular and wavy;
may have a silky sheen; without characteristic odor or
taste. Dust may irritate mucous membranes.

Weight: Basic specific gravity (ovendry weight/green volume)
0.45-0.59; air-dry density 35-45pcf.

Mechanical Properties: (First set of data based on the 2-cm
standard, second and third sets on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
		Psi	1,000 psi
Green (3)*	7,235	850	4,300
12%	8,855	1,060	6,420
15% (4)	12,000	1,480	6,000
12% (2)	12,310	1,640	6,140

Janka side hardness 750-1,160 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons slowly and with little or no degrade. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4 (West African species). Shrinkage green to ovendry: radial 2.4%; tangential 3.8%. Movement in service is rated as small.

Working Properties: Saws and machines well and works easily with hand tools and dresses smoothly but with some tearing of interlocked grain; glues well. Intense irritation may be caused by the sawdust.

Durability: Heartwood moderately durable but generally vulnerable to termite attack.

Preservation: Heartwood impermeable to preservatives; sapwood is treatable.

Uses: Furniture, joinery, flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res., Melbourne, Australia.
2. Bryce, J. M.
1966. The strength properties of Tanzania timbers. Util. Sec. For. Div. Tec. Note No. 35.
3. Tanganyika: For. Dep.
1966. Timbers of Tanganyika: Albizia versicolor. Util. Sec. For. Div. Moshi.
4. Uganda: For. Dep.
1972. Mugavu (Albizia coraria). Util. Sec. For. Dep. Timber Leaflet No. 48.

ALSTONIA CONGENSIS
and A. BOONEI

ALSTONIA

Family: Apocynaceae

Other Common Names: Mujwa, Mujua (Uganda), Emien (Ivory Coast), Sindru (Ghana), Ahun, Awun (Nigeria), Bokuk, Kanja (Cameroon), Kaiwi, Kauwi (Sierra Leone).

Distribution: Widely distributed throughout West and Central Africa; abundant in humid forests of the Cameroons.

THE TREE Reaches a height of 130 ft, boles usually cylindrical and clear to 80 ft; trunk diameters 2-4 ft over a deeply fluted and buttressed base.

THE WOOD General Characteristics: Wood yellowish-white with no distinction between sapwood and heartwood. Texture fine to medium; grain usually straight; luster low; without characteristic odor or taste. Large slitlike radial canals often occur at intervals of 1-3 ft.

Weight: Basic specific gravity (ovendry weight/green volume) 0.33; air-dry density 25 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	5,220	930	2,920
12%	8,560	1,200	5,240
12% (4)	7,000	840	3,920

Janka side hardness 370 lb for green and 410 lb for dry material. Amsler toughness 50 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons rapidly with little or no degrade due to warping and checking. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 4.0%; tangential 5.4%; volumetric 12.4%. Movement in service is rated as small.

Working Properties: Works easily with both hand and machine tools and dresses to a smooth finish if sharp cutting edges are used. Glues and nails well; steam bending properties are poor.

Durability: Wood is highly perishable and should be converted rapidly or given a chemical dip to prevent stain; liable to termite attack as well as powder-post beetle attack.

Preservation: Easily treated, absorptions over 30pcf of preservative oils are reported using either open tank or pressure systems.

Uses: Light construction, plywood core stock, boxes and crates, joinery, furniture components.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res., Melbourne, Australia.
2. France: Bois For. Trop.
1954. Emien (Alstonia congensis). Bois. For. Trop. No. 38:22-26.
3. Laver, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
4. Sallenave, P.
1955. Propriétés et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

ANDROSTACHYS JOHNSONII

MECRUSSE

Family: Androstachydaceae

Other Common Names: Lebombo ironwood, Nsimbitsi (Transvaal-South Africa), Cimbirre (Mozambique).

Distribution: Found in Southeast Africa, in mountainous areas along streams, frequently in pure stands.

THE TREE Reaches a height of 100 ft with a straight cylindrical bole to 50 ft; trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood light or medium brown, reddish tint, with darker markings; sapwood yellowish-white not sharply demarcated. Texture very fine and even; grain straight to irregular and wavy; somewhat lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72; air-dry density 55 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
12% (3)*	18,700	--	9,500

Janka side hardness 2,540 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons slowly, prone to surface checking, requires careful air drying using thin stickers and pile covers. A kiln schedule similar to T3-D2 has been suggested. Shrinkage green to ovendry: radial 5.8%; tangential 6.2%; volumetric 11.6%.

Working Properties: Reported to saw and machine without particular difficulty; a good turnery wood; gives a good finish; glues well.

Durability: Heartwood highly resistant to attack by decay fungi and termites.

Preservation: Very difficult to treat.

Uses: Flooring (parquet), heavy construction, railroad crossties, turnery, mine props.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. France: Bois For. Trop.
1965. Androstachys johnsonii. Bois. For. Trop. No. 103:60.
3. Portugal: Laboratório Nacional de Engenharia Civil.
1965. Ficha de características. Mecrusse. Androstachys johnsonii. Lab. Nac. Eng. Civil., Lisbon No. 5.

ANINGERIA spp.

ANINGERIA

Family: Sapotaceae

Other Common Names: Agnegre, Anegre (Ivory Coast), Landosan (Nigeria), Mukali, Kali (Angola), Osan, Mutoke (Uganda), Mukangu, Muna (Kenya).

Distribution: The genus is widespread in tropical Africa, particularly common in parts of East Africa.

THE TREE May reach a height of 180 ft with a clear cylindrical bole to 80 ft; trunk diameters above tall symmetrical buttresses 3-4 ft.

THE WOOD General Characteristics: Heartwood yellowish-white, pale brown, or pinkish-brown, darkening slightly after exposure; sapwood not well demarcated. Texture medium to coarse; grain usually straight, sometimes wavy; lustrous; faint cedarlike odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40-0.48; air-dry density 30-36 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	7,930	1,100	4,250
12%	7,980	1,170	5,260
12% (<u>5</u>)	13,000	--	7,000
12% (<u>3</u>)	15,000	1,610	7,500

Janka side hardness 740-1,250 lb for dry material. Amsler toughness 204 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well without degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 3.8%; tangential 7.0%; volumetric 11.8%.

Working Properties: Generally reported to saw and machine well, but some species are silicious and have a blunting effect on cutters; rather difficult to finish; cuts well on rotary lathe or slicer.

Durability: The wood is perishable, little resistance to attack by decay fungi and termites, liable to blue stain.

Preservation: Reported to have good treatability.

Uses: General carpentry, joinery, veneer and plywood, furniture components.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux Deuxième Supplément. Centre Tech. For. Trop.
4. Tack, C. H.
1958. The strength properties of some Uganda timbers. For. Dep. Bul. No. 5.
5. Uganda: For. Dep.
1956. Osan (Aningeria altissima) Timb. Leafl. For. Dep. Uganda No. 28.

ANTIARIS SPP.

ANTIARIS

Family: Moraceae

Other Common Names: Kyenkyen, Chenchen (Ghana), Mkuzu, Mlulu (Tanzania), Oro, Ogiou (Nigeria), Kirundo, Mumaka (Uganda), Ako (Dahomey, Senegal).

Distribution: Distributed throughout the high forest zone of West, Central, and East Africa on widely varying sites.

THE TREE Reaches a height of 120-150 ft with a straight, cylindrical bole clear to 70 ft; trunk diameters 2-5 ft; sometimes buttressed.

THE WOOD General Characteristics: Wood is whitish or light yellow-brown with no distinction between sapwood and heartwood. Texture medium to coarse; grain interlocked; lustrous; without characteristic odor or taste when dry, but has an unpleasant odor when green.

Weight: Basic specific gravity (ovendry weight/green volume) 0.38; air-dry density 27 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, second and third sets on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	4,770	810	2,930
12%	7,270	960	5,090
12% (<u>4</u>)	6,040	820	4,500
12% (<u>3</u>)	8,550	1,040	5,400

Janka side hardness 380 lb for green and 500 lb for dry material. Amsler toughness 50 in.-1b for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons rather rapidly but there is a pronounced tendency to warp, particularly twisting. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to ovendry: radial 4.2%; tangential 6.8%; volumetric 12.4%. Movement in service is rated as small.

Working Properties: Works easily with hand and machine tools but sharp cutters are needed; dresses smoothly, some tearing of interlocked grain; glues and nails satisfactorily.

Durability: Wood is perishable and liable to ambrosia beetle and powder-post beetle attack. Very susceptible to sap stain, requires rapid extraction and chemical treatments.

Preservation: Easy to treat using either open tank or pressure systems.

Uses: Veneer and plywood, furniture components, joinery, boxes and crates, light construction.

ADDITIONAL READING

1. Bryce, J. M.
1966. The strength properties of Tanzanian timbers.
For. Div. Util. Sec. Tec. Note No. 35.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
3. Lavers, G. M.
1967. The strength properties of timbers. For. Prod.
Res. Bul. No. 50. H. M. Stationery Office. London.
4. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois
tropicaux de l'union Française. Publ. Centre Tech.
For. Trop. No. 8.

AUCOUMEA KLAINEANA

OKOUMÉ

Family: Burseraceae

Other Common Names: Gaboon (U.K.), Angouma, Moukoumi, N'Koumi (Gabon).

Distribution: Confined to Gabon, Rio Muni, and Congo-Brazzaville; rather common, and extensively planted within its natural range.

THE TREE Reaches a height of 100-130 ft sometimes to 200 ft, boles cylindrical and clear to 70 ft and more; trunk diameters 3-8 ft over large buttresses.

THE WOOD General Characteristics: Heartwood salmon pink to light pinkish-brown; sapwood narrow, whitish or pale gray, not clearly demarcated from heartwood. Texture medium; grain straight, shallowly interlocked, sometimes wavy; sometimes lustrous; without characteristic odor or taste. Silica content of about 0.12-0.16% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.37; air-dry density 28pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	12,600	1,145	5,350

Janka side hardness 240 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries readily with little degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.1%; tangential 6.1%; volumetric 11.3%.

Working Properties: Saw teeth blunt rather quickly due to the silica content; machined surfaces are somewhat woolly but can be worked to a good finish; glues and nails well; easy to peel into veneer, bolts generally heated.

Durability: Heartwood is not resistant to attack by decay fungi and is susceptible to termite attack.

Preservation: Reported to be resistant to preservative treatments.

Uses: Plywood, furniture components, joinery, paneling, blockboard, particleboard, light construction.

ADDITIONAL READING

1. Becking, R. W.
1960. A summary of information on Aucoumea klaineana.
For. Abstr. 21(1;2):1-6; 163-172.
2. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res., Melbourne, Australia.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
4. France: Bois For. Trop.
1951. Okoumé (Aucoumea klaineana). Bois. For. Trop.
18/19:147-150.

AUTRANELLA CONGOLENSIS

MUKULUNGU

Family: Sapotaceae

Other Common Names: Elanzok, Elang (Cameroon), Kabulungu (Zaire).

Distribution: Widely distributed throughout the dense equatorial forests.

THE TREE Reaches a height of 120 ft and more; boles straight, cylindrical, and clear to long lengths; trunk diameters 4-6 ft; sometimes buttressed.

THE WOOD General Characteristics: Heartwood red to reddish-brown with darker streaks; sapwood grayish, not always sharply demarcated from the heartwood. Texture is fine and even; grain usually straight, sometimes interlocked; somewhat lustrous. Dust is very irritating to mucous membranes.

Weight: Basic specific gravity (ovendry weight/green volume) 0.78; air-dry density 60pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	21,800	--	12,700
12% (3)	23,000	2,150	11,900

Amsler toughness 282-398 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons slowly and should be quartersawn to minimize degrade. No information available on kiln schedules. Shrinkage green to ovendry: radial 5.8%; tangential 7.4%; volumetric 14.8%. Reported to have a large movement in service.

Working Properties: Saws and machines fairly easily but with dulling of tools due to silica content; dresses to a smooth finish; difficult to glue; good ventilation is required to remove irritating dust.

Durability: Heartwood is rated as very durable though there may be slight termite attack. Resistant to dilute acids. Good weathering characteristics.

Preservation: Highly impermeable.

Uses: Heavy construction, flooring, furniture and cabinet-making, acid vats, turnery, joinery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. France: Bois For. Trop.
1954. Mukulungu (Autranella congolensis). Bois For. Trop. 36:25-28.
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1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

BAIKIAEA INSIGNIS SUBSP. MINOR

NKOBAKOBA

Family: Leguminosae

Other Common Names: Nkoba (Uganda).

Distribution: Abundant in the South Budu forests of Uganda and the Bukoba district of Tanzania; found in riverain, lakeshore, and swampy localities.

THE TREE Reaches a height of 70-100 ft; boles usually 25-40 ft, rarely straight, crowns often wide spreading; trunk diameter about 2 ft, fluted at the base, buttresses rare.

THE WOOD General Characteristics: The wood is straw or more yellowish with a pinkish tinge turning a grayish-brown on drying, often marked with darker streaks, little or no distinction between sapwood and heartwood. Texture medium; grain straight; when worked, the wood has a green fig odor, tasteless.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65; air-dry density 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (4)*	17,035	2,615	9,460

Janka side hardness 1,770 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons well with little or no degrade except for end checking and moderate cup. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to air dry: radial 2.3%; tangential 4.5%. Movement in service is rated as medium.

Working Properties: Green timber difficult to saw because gummy sawdust clogs the teeth and blade; but works easily with hand and machine tools, some tearing of grain in planing.

Durability: The wood is rated as nondurable and is very liable to beetle and termite attack.

Preservation: Sapwood is moderately resistant to impregnation, absorbing about 10pcf of preservative oil using a pressure system, however, lateral penetration was shallow.

Uses: Flooring, heavy construction (treated), furniture components.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzanian For. Div. Util. Sect. Moshi.
3. Uganda: For. Dep.
1954. Nkobakoba (Baikiaea minor) Uganda For. Dep. Leafl. No. 16.
4. Wyk, J. H. van.
1955. Physical and mechanical properties of the woods of Manilkara cuneifolia and Baikiaea minor from Uganda. Trop. Woods No. 102:50-54.

BAIKIAEA PLURIJUGA

RHODESIAN-TEAK

Family: Leguminosae

Other Common Names: Zambesi redwood, Umgusi, Mukushi (Rhodesia).

Distribution: Dry regions of Zambia and Rhodesia and bordering areas to the west.

THE TREE A small tree 50-60 ft in height with a short bole of 10-15 ft and a trunk diameter seldom more than 2 ft.

THE WOOD General Characteristics: Heartwood an attractive reddish-brown with irregular black lines or flecks; sapwood pale pinkish-brown, sharply demarcated from the heartwood. Texture fine and even; grain straight or slightly interlocked; luster low; without characteristic odor or taste. Moist wood in contact with iron may stain because of tannin content.

Weight: Basic specific gravity (ovendry weight/green volume) 0.73; air-dry density 56 pcf.

Mechanical Properties:

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
12% <u>(1)*</u>	12,220	1,230	9,600

Janka side hardness 2,990 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries slowly with little or no degrade. Kiln schedule T3-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial 1.5%; tangential 2.5%. Movement in services is rated as small.

Working Properties: Rather difficult to saw and machine with severe blunting of cutters, gumming of teeth if sawn green; excellent turnery; good gluing.

Durability: Heartwood is rated as very durable; moderately resistant to termite attack. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood moderately resistant.

Uses: Mainly used in flooring.

ADDITIONAL READING

1. Banks, C. H.
1954. The mechanical properties of timbers with particular reference to those grown in the Union of South Africa. J. S. African For. Assoc. 24:44-65.
2. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

BAILLONELLA TOXISPERMA

MOABI

Family: Sapotaceae

Other Common Names: Njabi (Nigeria, Cameroon), Adza (Gabon), African Pearwood (U.K.), Dimpampi (Congo).

Distribution: Found in the dense forests of Equatorial Africa, often in small patches on dry or moist soils.

THE TREE Reaches a height of 200 ft with straight cylindrical boles to 100 ft; trunk diameters 6 ft, reaching to 10 ft, some butt swelling in older trees.

THE WOOD General Characteristics: Heartwood pinkish-brown, red-brown, or a rich red; sapwood pinkish-white or gray-brown, rather well demarcated. Texture is fine and even; grain straight, sometimes wavy; has an attractive figure; dust may affect mucous membranes.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65-0.77; air-dry density 50-60 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
12% (3)*	21,500	--	9,600
12% (3)	25,300	2,200	12,200

Amsler toughness 242-665 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries slowly and with care seasons without checking and warping. No information available on kiln schedules. Shrinkage green to ovendry: radial 5.9%; tangential 7.5%; volumetric 12.6%. Stable.

Working Properties: Because of silica content there is a rapid dulling of cutters, otherwise works easily; glues and finishes well; has good steam bending properties.

Durability: Heartwood is rated as very durable, resistant to termite attack; and is reported to be rarely attacked by marine borers.

Preservation: Reported to be not treatable (hot and cold bath).

Uses: Furniture, cabinetwork, decorative flooring, turnery and carving, decorative veneers, joinery, store fittings.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. France: Bois For. Trop.
1956. Moabi (Baillonella toxisperma). Bois For. Trop. No. 45:27-30.
3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

BERLINIA SPP.

BERLINIA

Family: Leguminosae

Other Common Names: Ekpogoi (Nigeria), Ebiara (Gabon), Melegba (Ivory Coast), Essaben, Abem (Cameroon).

Distribution: West Africa and reaching into Zaire. Found in various forest types: savanna formations, marshy localities, or dense high forests.

THE TREE Reaches a height of 100-130 ft, boles often irregular sometimes fluted with low buttresses; trunk diameters 3-5 ft.

THE WOOD General Characteristics: Heartwood brown, pinkish-brown to deep red-brown, with dark purple or brown streaking; sapwood rather wide, whitish, often with a pink tint, clearly demarcated. Texture medium to coarse; grain straight, interlocked, or irregular; without characteristic odor or taste when dry. Traumatic gum ducts frequently present.

Weight: Basic specific gravity (ovendry weight/green volume) averaging about 0.58; air-dry density 44pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,500	1,320	4,930
12%	15,300	1,570	7,690
12% (4)	17,200	1,720	8,000
12% (4)	13,200	1,270	8,000

Janka side hardness 1,000 lb for green material and 1,360 lb for dry. Amsler toughness 180 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons rather slowly and well with only occasional degrade due to warping. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.4%; tangential 8.9%; volumetric 12.4%. Movement in service is rated as medium.

Working Properties: Saws easily and generally works well with hand and machine tools but there is some tearing of interlocked grain; good gluing properties; rated as a moderate steam bending wood.

Durability: Heartwood durability variable with species, generally moderately resistant to attack by decay fungi and moderately resistant to termite attack. Logs liable to severe attack by ambrosia beetles and sapwood vulnerable to powder-post beetles.

Preservation: Heartwood is rated as resistant to preservative treatments, sapwood is permeable.

Uses: Heavy construction, furniture and cabinetwork, decorative veneers, paneling. Often suggested as an oak substitute.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Lavers, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
4. Sallenave, P.
1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Centre Tech. For. Trop. No. 23.

BOMBAX SPP.

BOMBAX

Family: Bombacaceae

Other Common Names: Alone, Ogoumalanga (Gabon), Msufi-mwitu, Mfume (Tanzania), Meguza (Mozambique), Kapokier (Senegal).

Distribution: West Africa and extending eastward into Tanzania; found in savanna and secondary forests as well as dense rain forests.

THE TREE Height ranges 80-120 ft, bole straight and cylindrical; trunk diameters 4-6 ft, some species buttressed.

THE WOOD General Characteristics: Heartwood pale reddish-brown, yellowish-brown, or light brown with a purplish tint, sometimes with darker markings; sapwood whitish, not always sharply differentiated. Texture medium to coarse; grain usually straight; without luster; sometimes with gum veins.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.40; air-dry density 30 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, second and third sets on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	4,310	730	2,380
12%	6,790	880	4,460
12% (3)	10,800	1,050	5,400
12% (3)	6,300	--	4,700

Janka side hardness 390 lb for green material and 400 lb for dry. Amsler toughness 94-111 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly with severe cup, sometimes with collapse, honeycomb, and checking. A kiln schedule similar to T6-B3 has been suggested. Shrinkage green to ovendry: radial 4.9%; tangential 8.1%. Movement in service is rated as small.

Working Properties: Usually saws easily and works well with hand and machine tools but cutters must be kept sharp; glues and finishes well; easy to rotary peel veneers.

Durability: Heartwood perishable, not resistant to termite attack; sapwood vulnerable to powder-post beetle attack. Rapid extraction and conversion necessary to prevent deterioration from stain, decay, and insect attack.

Preservation: Heartwood moderately to extremely resistant to preservative treatment; sapwood permeable.

Uses: Plywood core stock, block board, boxes and crates, furniture components.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
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3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.
4. Tanzania: For. Div.
1966. Timbers of Tanganyika. Bombax rhodognaphalon (East African bombax, msufi-mwitu). For. Div. Util. Sec. Moshi.

BRACHYLAENA HUTCHINSII

MUHUHU

Family: Compositae

Other Common Names: Muhugwe, Mkarambaki, Ol Magogo (Tanzania).

Distribution: Common in the dry coastal forests of Tanzania and Kenya, also recorded in Uganda.

THE TREE Commonly 30-60 ft in height; bole twisted and fluted to 20 ft; trunk diameter 1-1/2 to 2 ft; stem often hollow.

THE WOOD General Characteristics: Heartwood bright yellow-brown when freshly sawn, becoming yellowish- or greenish-brown on drying; sapwood grayish-white, distinct. Texture fine and even; grain straight, closely interlocked, or wavy; with an aromatic spicy scent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.75; air-dry density about 58 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	13,300	1,250	7,770
12%	16,200	1,460	10,200

Janka side hardness 1,880 lb for green material and 2,190 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons rapidly with a tendency to checking but no warping, thick stock dries slowly with severe checking. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to 12% moisture content: radial 2.0%; tangential 3.0%. Movement in service is rated as small.

Working Properties: Because of irregular grain and high density the timber is difficult to work, moderate blunting of cutters, tools tend to collect gum, shapes and turns well, difficult to glue, takes a high polish.

Durability: Heartwood is rated as very durable, and with good resistance to termites and marine borers.

Preservation: Extremely resistant to impregnation.

Uses: High quality flooring, carving, turnery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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BRACHYSTEGIA SPICIFORMIS

MTUNDU

Family: Leguminosae

Other Common Names: Messassa (Mozambique), Mundu, Myombo, Mtondo (Tanzania), Muputu (Zambia).

Distribution: Savanna forests of East Africa, mostly Tanzania, Zambia, and Mozambique; reaching from the coastal belt to the highlands.

THE TREE In moister areas may exceed a height of 80 ft with a clear bole of 30 ft; trunk diameters 1-3 ft; heavily branched.

THE WOOD General Characteristics: Heartwood variable from pale brown to a red-brown, darkening on exposure, striping sometimes present; sapwood creamy or white, clearly demarcated. Texture coarse; grain irregular and interlocked; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.67; air-dry density 51 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	17,300	2,080	9,570

Janka side hardness 1,830 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries slowly with some tendency to warp, mostly twist, appreciable checking and end splitting. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 3.0%; tangential 4.4%. Movement in service is rated as medium.

Working Properties: The timber is difficult to work and to saw, moderate blunting of cutters, interlocked grain liable to tear in planing, sands to a good finish and polishes well, very poor steam bending properties.

Durability: Nondurable and vulnerable to termite attack; sapwood readily attacked by staining fungi.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood is moderately resistant.

Uses: General construction work, furniture components, parquet flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzanian For. Div. Util. Sec. Moshi.
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1961. Timbers of Tanganyika: Brachystegia spiciformis, Mtundu. Util. Div. For. Dep. Moshi.

BRACHYSTEGIA SPP.

OKWEN

Family: Leguminosae

Other Common Names: Achi, Ngu, Akolodo (Nigeria), Meblo (Ivory Coast), Naga (Cameroon), Mendou (Gabon).

Distribution: A commercial grouping of four species of Brachystegia found in west Africa; common and gregarious in the wetter high forests of Nigeria.

THE TREE A tall emergent 120 to 150 ft in height, boles are straight and cylindrical, trunk diameter 4 to 7 ft above the buttresses.

THE WOOD General Characteristics: Heartwood light to dark brown; sapwood yellow to yellowish-brown, well defined. Texture medium to coarse; grain usually deeply interlocked producing a pronounced roe figure; luster high.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.45-0.53; air-dry density 34 to 44 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	11,400	1,280	5,720
12%	15,200	1,530	8,270
12% (3)	12,300	1,190	6,230

Janka side hardness 930-1,430 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rather slowly with a marked tendency to check and warp. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial about 2.5%; tangential about 3.5%. Movement in service is rated as medium.

Working Properties: Difficult to saw because of gumming of teeth, blunting may be serious, machines moderately well, good turning characteristics, difficult to plane to a smooth surface because of severe tearing of grain in B. nigerica.

Durability: Heartwood is rated as moderately durable, sapwood liable to attack by powder-post beetles.

Preservation: Heartwood is extremely resistant to treatment, sapwood is permeable.

Uses: Parquet flooring, decorative veneer, general construction where high durability is not required, joinery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Nigeria: Dep. For. Res.
1966. Brachystegia kennedyi (Okwen). For. Prod. Res. Rep. Dep. For. Res. Nigeria No. FPRL/7.
4. Nigeria: Dep. For. Res.
1966. Brachystegia nigerica (Okwen). For. Prod. Res. Rep. Dep. For. Res. Nigeria No. FPRL/8.

BURKEA AFRICANA

BURKEA

Family: Leguminosae

Other Common Names: Mgando, Mkarati, Msangala (Tanzania).

Distribution: Widely distributed in dry savanna forests from Nigeria southward to the Transvaal.

THE TREE A small to medium-sized tree to 50 to 70 ft in height, with a bole length of 15 to 20 ft; trunk diameters 1 to 2 ft. Heart of the tree is often decayed.

THE WOOD General Characteristics: Heartwood dark brown or reddish-brown; sapwood whitish or yellowish, not always sharply defined. Texture moderately fine; grain interlocked or wavy; lustrous.

Weight: Basic specific gravity (ovendry weight/green volume) 0.60-0.80; air-dry density 46-61 pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Dries rather rapidly with little warping or splitting. No information available on kiln schedules. Shrinkage green to 12% moisture content: radial 1.2%; tangential 2.1%. Little movement in service.

Working Properties: Not difficult to saw but is difficult to work with hand and machine tools, tends to tear in planing, glues well, takes a good finish.

Durability: Heartwood is rated as very durable and is immune to termite attack.

Preservation: Heartwood is extremely resistant to preservative treatments, sapwood is permeable.

Uses: Parquet flooring, fine cabinet and furniture work, joinery, railroad crossties, mining timbers.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzanian For. Div. Util. Sec. Moshi.
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CANARIUM SCHWEINFURTHII

AFRICAN CANARIUM

Family: Burseraceae

Other Common Names: Abel (Cameroon), Aiélélé (Ivory Coast), Elemi (Nigeria), Bediwunua, Eyere (Ghana), Mwafu (Uganda).

Distribution: Widely distributed in East, Central, and West Africa.

THE TREE Reaches a height of 150 ft with a straight cylindrical bole to 90 ft, trunk diameters 4-5 ft over a slight buttress.

THE WOOD General Characteristics: Heartwood a light pinkish-brown or light pinkish-yellow; sapwood whitish or straw colored, wide, not clearly differentiated. Texture somewhat coarse; grain interlocked sometimes producing a very attractive roe figure; lustrous; pleasant characteristic scent, without taste.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.40; air-dry density 30 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	5,900	900	3,130
12%	10,100	1,180	6,160
12% (4)	8,740	--	4,830
12% (4)	10,750	1,310	6,240

Janka side hardness 520 lb for green material and 670 lb for dry. Amsler toughness at 12% moisture content 88-128 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Timber seasons slowly, possibly with some collapse and a tendency to end checking and warp. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to 12% moisture content: radial 2.5%; tangential 4.5%. Movement in service is rated as medium.

Working Properties: Timber works easily with machine and hand tools but has a severe blunting effect on cutters because of silica content, sharp knives are required to avoid a woolly finish in planing, glues and nails satisfactorily, peels and slices easily.

Durability: Heartwood not resistant to decay and is vulnerable to termite attack; sapwood liable to attack by powder-post beetles. Logs must be protected with insecticides and fungicides and converted as soon as possible.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood is permeable.

Uses: Plywood, decorative veneers, parquetry, joinery, furniture components.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Farmer, R. H. (ed.).
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3. Lavers, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
4. Sallenave, P.
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CARAPA PROCERA
and C. GRANDIFLORA

AFRICAN CRABWOOD

Family: Meliaceae

Other Common Names: Gobi, Kowi (Sierra Leone), Toon-kor-dah (Liberia), Alla, Dona (Ivory Coast), Bete, Krupi (Ghana), Agogo (Nigeria), Mujogo, Mutongana (Uganda).

Distribution: Widely distributed in western sections of tropical Africa and extending eastward to Uganda; the range of both species overlap in Angola and Zaire.

THE TREE Attains a height of about 50 ft; mature stems fairly straight, usually fluted, small buttresses; diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood pink when freshly cut, turning to a reddish-brown with a golden luster; sapwood pinkish-gray or light brown, well demarcated in C. procera. Grain straight, wavy, or interlocked; texture variable from fine to coarse; high luster; a bitter taste but no odor.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.53-0.65; air-dry density 40-50 pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Generally air dries well with little degrade, logs prone to end-splitting. No information available on kiln schedules or shrinkage values. Movement in service is rated as moderate to small.

Working Properties: Reported to be easy to work and takes a smooth finish, some tearing of interlocked grain in planing, turns well, easy to glue.

Durability: Only moderately resistant to attack by decay fungi and termites.

Preservation: Heartwood reported to be extremely resistant to preservative treatments.

Uses: Joinery, furniture, flooring, used in Uganda for mine work.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Eggeling, W. J., and C. M. Harris.
1939. Fifteen Uganda timbers. Clarendon Press, Oxford.

CASEARIA BATTISCOMBEI

MUIRUNG'I

Family: Flacourtiaceae

Other Common Names: Casearia, Mlikawandu, White Matua (Tanzania).

Distribution: Common in the montane rain forests of the Northern Province of Tanzania, also in Uganda and Kenya.

THE TREE A total height of 80-90 ft with 30-ft bole; buttresses up to 6 ft; stem diameter 2-3 ft.

THE WOOD General Characteristics: Timber is mainly sapwood, whitish to pale yellow-brown with red streaks; heartwood limited to a narrow dark-brown core. Texture fine and even; grain straight; has an unpleasant odor when freshly sawn, disappears on drying.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	11,700	1,500	6,620

Janka side hardness 720 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Air dries moderately slowly with some tendency to warp. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to air dry: radial 1.9%; tangential 4.9%.

Working Properties: Works easily with machine and hand tools, dresses to a smooth surface, easy to nail. Sawdust can be irritating to mucous membranes.

Durability: Wood is vulnerable to attack by decay fungi and termites, liable to blue stain.

Preservation: Sapwood is easily treated using either open-tank or pressure-vacuum systems. Absorption of over 15 pcf of preservative oils is reported.

Uses: Boxes and crates, interior joinery, furniture components.

ADDITIONAL READING

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1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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1961. Timbers of Tanganyika: Casearia battiscombei (Casearia). For. Dep. Util. Sec. Moshi.

CASSIPOUREA MALOSANA

PILLARWOOD

Family: Rhizophoraceae

Other Common Names: Ndiri, Msengeria, Funzare (Tanzania), Musaisi (Kenya).

Distribution: A high mountain forest tree, 6,000-9,000 ft elevation in Uganda, Tanzania, and Kenya; also in Somalia and Ethiopia.

THE TREE Reaches a height of 90-110 ft; boles to 50-70 ft, straight, cylindrical, free of buttresses; trunk diameters 1-2 ft.

THE WOOD General Characteristics: Sapwood and heartwood not differentiated, whitish to light-brown, often with purplish streaks associated with fungal attack. Texture fine and even; grain usually straight but with a slight to marked tendency to spiraling.

Weight: Basic specific gravity (ovendry weight/green volume) 0.59; air-dry density 47 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard, second set on the 2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	9,130	1,145	4,500
12%	19,200	1,670	8,900
Green (2)	11,700	1,650	4,850
12%	15,500	1,800	9,420

Janka side hardness 900-990 lb for green material and 1,250-1,650 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly and is subject to severe distortion, particularly twist, checking is slight. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4 but degrade due to warp and end-checking should be expected. Shrinkage green to air dry: radial 3.5%; tangential 3.0%. Movement in service is rated as medium.

Working Properties: Sawing of green timber is difficult because of a strong tendency to spring; rather easy to work dry wood with hand and machine tools, dressing to a smooth clean finish; suitable for turnery; somewhat troublesome to glue.

Durability: Classified as nondurable and not resistant to termite attack.

Preservation: Heartwood is rated as extremely resistant to preservative treatments; sapwood is rated as moderately resistant.

Uses: Flooring, turnery, tool handles.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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CEIBA PENTANDRA

CEIBA
SILK-COTTON-TREE

Family: Bombacaceae

Other Common Names: Fromager, Enia (Ivory Coast), Ngwe, Banda (Sierra Leone), Ghé (Liberia), Araba, Okha (Nigeria), Doum, Bouma, Odouma (Cameroon, Gabon), Fuma (Congo Rep.).

Distribution: Widely distributed in West Africa, more or less scattered in secondary forest formations. Also found in tropical America and southeast Asia.

THE TREE A large tree to 200 ft with a straight, cylindrical bole 40-60 ft long; trunk diameters 6 ft and more over large buttresses. Stems of young trees are covered with conical spines.

THE WOOD General Characteristics: Sapwood and heartwood not clearly demarcated, wood is whitish, pale brown, or pinkish-brown, often with yellowish or grayish streaks. Texture coarse; grain interlocked, occasionally irregular; luster low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.26; air-dry density 20 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	5,800	600	3,150

Amsler toughness 78 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons rapidly without marked distortion. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 2.8%; tangential 6.4%; volumetric 10.4%.

Working Properties: Difficult to saw cleanly and to dress smoothly, cut surfaces tend to be woolly, tools must be kept sharp for best results, easy to nail and glue, peels to give good veneers.

Durability: Very susceptible to attack by decay fungi and insects, requires rapid harvest and conversion to prevent deterioration, liable to powder-post beetle attack, prone to stain.

Preservation: Good treatability.

Uses: Plywood, blockboard, boxes and crates, joinery, furniture components. Seed pods yield a silky hair (kapok).

ADDITIONAL READING:

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO Div. of Build. Res. Melbourne, Australia.
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CELTIS SPP.

AFRICAN CELTIS

Family: Ulmaceae

Other Common Names: Esa (Ghana), Ba (Ivory Coast), Akasinsa (Uganda), Ita, Ohia (Nigeria), Mrinde, Mrunde (Tanzania).

Distribution: Trees are found in western, central, and parts of eastern Africa; locally frequent in the drier high forests.

THE TREE Up to 130 ft in height with a clear straight bole to 80 ft; trunk diameters to 3 ft over short to long buttresses.

THE WOOD General Characteristics: Heartwood and sapwood not clearly demarcated, whitish or light yellow, becoming grayish-white on exposure often with dark irregular markings. Texture rather fine to coarse; grain straight to irregular, wavy, or interlocked; lustrous; has an apple-like scent in C. africana.

Weight: Basic specific gravity (ovendry weight/green volume) variable with species 0.52-0.65; air-dry density 40-50 pcf.

Mechanical Properties: (First and third sets of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	13,050	1,850	6,500
12%	20,900	2,300	10,550
12% (<u>2</u>)	14,700	1,620	--
12% (<u>5</u>)	11,500	1,700	6,150

Janka side hardness 1,390 lb for green material and 1,670 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with little degrade, some end-checking and warp may occur. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 5.6%; tangential 10.4%; volumetric 15.4%. Movement in service is rated as medium.

Working Properties: Generally reported easy to work in machining operations but rather difficult with hand tools; tearing of interlocked grain in planing, poor surfaces in shaping; nails and glues easily; moderate steam-bending qualities.

Durability: Highly susceptible to attack by decay and staining fungi as well as insect damage, including powder-post beetle attack.

Preservation: Heartwood rated as moderately resistant to preservative treatment, sapwood is permeable.

Uses: Flooring, tool handles, plywood, general construction, decorative veneer.

ADDITIONAL READING:

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO Div. of Build. Res. Melbourne, Australia.
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CEPHALOSPHAERA USAMBARENSIS

MTAMBARA

Family: Myristicaceae

Other Common Names: Mtambao (Tanzania).

Distribution: Occurs in isolated patches in evergreen rain forests of Tanzania, on steep mountain slopes at altitudes of 3,000-4,000 ft.

THE TREE Commonly 150 ft or more in height; bole is straight, cylindrical, without flutes and usually without buttresses, 50-80 ft in length; trunk diameters 4-5 ft.

THE WOOD General Characteristics: Heartwood and sapwood not differentiated, light reddish-brown. Texture medium; grain usually straight; without figure.

Weight: Basic specific gravity (ovendry weight/green volume) 0.48; air-dry density 37pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	13,500	2,450	6,430

Janka side hardness 740 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Air-dries slowly with little degrade but can be kiln dried rapidly with only moderate cup developing. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to 12% moisture content: radial 3.0%; tangential 6.5%. Movement in service is rated as large.

Working Properties: Exceptionally easy to work with hand and machine tools and dresses to a good finish, nails easily and glues well, easy to peel into veneers.

Durability: The wood is vulnerable to attack by stain and decay fungi, liable to ambrosia beetle attack if extraction after felling is delayed.

Preservation: Both heartwood and sapwood are rated as moderately resistant to preservative treatments, though absorptions of over 20pcf of preservative oil using a pressure treatment is reported.

Uses: Construction, joinery, furniture, boxes and crates, plywood, a general all-purpose utility wood.

ADDITIONAL READING:

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1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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CHLOROPHORA EXCELSA
and C. REGIA

IROKO

Family: Moraceae

Other Common Names: Semli (Sierra Leone, Liberia), Odoum (Ghana, Ivory Coast), Rokko, Oroko (Nigeria), Abang, Mandji (Cameroon, Gabon), Mereira (Angola), Kambala (Zaire), Mvule (East Africa).

Distribution: The two species, between them, extend across the entire width of tropical Africa. C. regia limited to the extreme west of Africa from Gambia to Ghana and is less drought resistant.

THE TREE May reach a height of 160 ft, bole straight, cylindrical and clear to 80 ft, small buttresses sometimes present.

THE WOOD General Characteristics: Heartwood varies from a pale yellowish-brown to dark chocolate brown with lighter markings most conspicuous on flat-sawn surfaces; sapwood yellowish-white, clearly demarcated. Texture medium to coarse; grain typically interlocked, sometimes irregular; slightly greasy feel; without odor; wet sawdust may cause dermatitis; occasional large "stone" deposits of calcium carbonate.

Weight: Basic specific gravity (ovendry weight/green volume) 0.55; air-dry density about 43 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,700	1,200	5,120
12%	13,100	1,360	7,910
12% (4)	11,200	--	3,450
12% (4)	13,800	--	7,150

Janka side hardness 1,080 lb for green and 1,260 lb for dry material. Amsler toughness 166-248 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly with little or no degrade.

Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.8%; tangential 3.8%; volumetric 8.8%. Movement in service is rated as small.

Working Properties: Works fairly easily with hand or machine tools but with some tearing of interlocked grain; occasional deposits of calcium carbonate severely damage cutting edges; good nailing and gluing characteristics; moderate steam-bending properties; may cause dermatitis in working wet wood.

Durability: Heartwood is very durable and is resistant to termite and marine borer attack as well. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood is permeable.

Uses: Suggested as a teak substitute. Joinery, boatbuilding, piling and marine work, domestic flooring, furniture, veneer, railroad crossties, cabinetwork, shop fittings.

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COMBRETODENDRON MACROCARPUM
SYN. C. AFRICANUM

ESSIA

Family: Lecythidaceae

Other Common Names: Abalé (Ivory Coast), Owewe (Nigeria),
Abing (Cameroon), Abin (Gabon), Minzu (Zaire).

Distribution: Throughout tropical West Africa, fairly common
in wet forest areas, infrequent in the dry high forests.

THE TREE Up to 120 ft or more in height; bole straight and cylindrical,
sometimes shallowly fluted, 60-80 ft long, unbuttressed
but flared at the base; trunk diameters 2-1/2 to 5 ft.

THE WOOD General Characteristics: Heartwood reddish to dark red-brown,
sometimes with darker streaks; sapwood yellowish-white,
clearly demarcated. Texture fine to moderately coarse;
grain varying from straight to interlocked; when freshly-
cut wood has a rotten cabbage odor which disappears on
drying.

Weight: Basic specific gravity (ovendry weight/green volume)
about 0.70; air-dry density 53 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	20,300	2,100	10,850
12% (3)	16,600	1,520	8,100
12% (4)	15,400	1,830	7,400

Janka side hardness 2,180 lb for dry material.
Amsler toughness 232-250 in.-lb for dry material
(2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly and is very prone to warping and checking, thick stock liable to collapse and honeycomb. Kiln schedule T2-C2 is suggested for 4/4 stock, very difficult to dry thicker stock. Shrinkage green to ovendry: radial 5.4%; tangential 10.4%; volumetric 14.2%. Movement in service is rated as large.

Working Properties: Rather difficult to work, saws moderately well, dresses to good finish but there is tearing of interlocked grain, may char in boring, has poor steam-bending qualities, glues satisfactorily.

Durability: Heartwood is resistant to moderately resistant to attack by decay fungi and termites, sometimes damaged by pinhole borers.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood is permeable.

Uses: Sliced to produce decorative veneers, heavy construction work where end splitting and checking are not objectionable.

ADDITIONAL READING

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1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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3. Sallenave, P.
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1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Publ. Centre Tech. For. Trop. No. 23.

CORDIA MILLENII
and C. PLATYTHYRSA

WEST AFRICAN CORDIA

Family: Boraginaceae

Other Common Names: Omo (Nigeria), Ébé (Cameroon).

Distribution: Widely distributed in tropical Africa, found in closed forests and old secondary formations.

THE TREE Grows to a height of 60-100 ft, bole cylindrical, but rarely straight, 30-40 ft in length; trunks about 3 ft in diameter above buttresses.

THE WOOD General Characteristics: Heartwood pale golden-brown to medium brown, occasionally with a pinkish tint; sapwood lighter. Texture coarse; grain typically interlocked to give a stripe figure; lustrous; brittleheart fairly common.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.34; air-dry density 25 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	7,800	880	3,810
12%	9,700	1,000	5,200
12% (4)	9,150	--	4,050

Janka side hardness 550 lb for green and 590 lb for dry material. Amsler toughness 105 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly and well with only a slight tendency to warp. A high temperature kiln schedule is necessary to remove moisture pockets. Kiln schedule T13-C4S is suggested for 4/4 stock and T11-D3S for 8/4. Shrinkage green to ovendry: radial 3.4%; tangential 4.6%; volumetric 7.5%. Movement in service is rated as small.

Working Properties: Works well with hand and machine tools and is easy to finish, in planing there is some tearing of interlocked grain, nails satisfactorily.

Durability: Generally heartwood may be rated as moderately durable.

Preservation: Reported to be resistant to preservative treatments.

Uses: Fine furniture and cabinetwork, joinery, and other decorative work where strength is not important.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Lavers, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
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CORDYLA AFRICANA

CORDYLA

Family: Leguminosae

Other Common Names: Mroma, Mpachamu, Mgwata (Tanzania).

Distribution: Locally common in riparian and swamp forests throughout northern and eastern Tanzania.

THE TREE Reaches a height of 110 ft with a bole length of 50 ft, usually curved, without buttresses; trunk diameter to about 3 ft.

THE WOOD General Characteristics: Heartwood yellowish-brown with darker bands; sapwood 2-3 in. wide, pale yellow, moderately distinct. Texture coarse; grain wavy or interlocked, showing an attractive stripe figure; cut surfaces somewhat oily.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 54pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	11,600	1,740	3,320

Janka side hardness 1,580 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly with some tendency to check but with little warp. No information available on kiln schedules. Shrinkage green to 12% moisture content: radial 3.8%; tangential 5.3%. Movement in service is rated as medium.

Working Properties: Moderately easy to work with machine tools, shapes cleanly except where grain is irregular, drills and mortises well, difficult to work with hand tools, does not dress smoothly in turnings.

Durability: Heartwood is rated high in durability, not liable to termite attack.

Preservation: Heartwood is extremely resistant to preservative treatments.

Uses: General heavy construction, railroad crossties.

ADDITIONAL READING

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2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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1966. Timbers of Tanganyika: Cordyla africana (Mroma). Util. Sec. For. Div. Moshi.

CROTON MEGALOCARPUS

MUSINE

Family: Euphorbiaceae

Other Common Names: Mlalai, Muhande (Tanzania).

Distribution: Occurs in tropical East Africa, with an altitudinal range of 4,000-6,700 ft; used as a shade tree in coffee plantations.

THE TREE May reach a height of 120 ft; with a clear cylindrical bole 40-60 ft in length, free of buttresses; with trunk diameters of 2-4 ft.

THE WOOD General Characteristics: Heartwood yellowish- to brownish-gray, sometimes with dark brown to black streaks near the center of the log; sapwood not clearly differentiated. Texture medium; grain straight; unpleasant smell when freshly cut; dry sawdust irritating to nose and throat.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 44 pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,500	--	6,600
12%	14,000	--	7,500

Janka side hardness 1,300 lb for green material and 1,350 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Rather difficult to season without warping and checking. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. No data available on shrinkage values. Movement in service is large.

Working Properties: Reported to be easy to saw, moderately difficult to machine but planes to a smooth lustrous surface, good gluing and finishing characteristics. Dust may be irritating to mucous membranes.

Durability: Vulnerable to attack by decay and stain fungi and liable to termite attack.

Preservation: Reported to be readily treatable by pressure systems.

Uses: General construction, heavy-duty flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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1972. Handbook of hardwoods. H. M. Stationery Office. London.

CYLCODISCUS GABUNENSIS

OKAN

Family: Leguminosae

Other Common Names: Denya (Ghana), Edum (Gabon), Adoum, Bokoka (Cameroon), Bouémon (Ivory Coast).

Distribution: A large tree 180-200 ft in height, bole straight, cylindrical, and clear to 80 ft; trunk diameters about 3-4 ft but may reach 8-10 ft above short buttresses.

THE TREE Common in the rain forests of Sierra Leone to the Cameroons and Gabon.

THE WOOD General Characteristics: Heartwood yellow to golden brown, often with a slight greenish tinge, darkening on exposure to a reddish-brown; sapwood 2-3 in. wide, pale pink, distinct. Texture moderately coarse, grain interlocked; lustrous; disagreeable odor when freshly cut, but without odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume) 0.80; air-dry density about 60 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	14,700	1,850	8,230
12%	20,300	2,330	12,380
12% (4)	25,800	2,560	14,200

Janka side hardness 2,540 lb for green material and 2,780 lb for dry. Amsler toughness about 400 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly with a marked tendency to surface and end check but warping is not serious. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 6.0%; tangential 8.8%; volumetric 12.6%.

Working Properties: Rather difficult to saw with some dulling, difficult to work with hand and machine tools, tearing of interlocked grain in planing, turns well, glues and finishes well.

Durability: Heartwood is very durable and highly resistant to termite attack; sapwood liable to powder-post beetle attack. Resistant to marine borers, excellent weathering properties, and has high resistance to wear.

Preservation: Heartwood extremely resistant, sapwood resistant.

Uses: Marine piling and dockwork, heavy-duty flooring, railroad crossties, heavy construction.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois. For. Trop.
1955. Okan (Adoum) [Cylcodiscus gabunensis]. Bois For. Trop. No. 43:11-14.
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CYNOMETRA ALEXANDRI

MUHIMBI

Family: Leguminosae

Other Common Names: Muhindi (Uganda).

Distribution: Central and East Africa, usually representing a somewhat dry type of forest, but not uncommon as a constituent of forest swamps, normally gregarious.

THE TREE Reaches a height of 120-150 ft with a wide low-branched crown and a clear bole rarely more than 40 ft, trunk diameters about 4-5 ft above large plank-like buttresses; larger trees usually hollow.

THE WOOD General Characteristics: Heartwood dull reddish-brown with darker markings; sapwood grayish, turning pale yellow, clearly defined. Texture fine; grain usually interlocked; without luster; sometimes figured.

Weight: Basic specific gravity (ovendry weight/green volume) 0.74; air-dry density 54 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	13,700	1,430	7,030
12%	21,900	2,050	10,400
12% (1)	21,450	2,341	11,070

Janka side hardness 2,540-3,410 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly with a tendency to surface and end checking, but with little warp. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to 12% moisture content: radial 2.5%; tangential 4.5%. Movement in service is rated as medium.

Working Properties: Fairly difficult to work with hand and machine tools, rather severe blunting effect on cutters, turns very well, moderate steam-bending properties.

Durability: Heartwood is rated as durable and highly resistant to termite attack. Resistant to abrasion.

Preservation: Sapwood permeable to preservative treatments.

Uses: Industrial and heavy-duty flooring, heavy construction including marine work, railroad crossties.

ADDITIONAL READING

1. Banks, C. H.
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2. Bolza, E., and W. G. Keating.
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3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

DACRYODES spp.

ADJOUABA

Family: Burseraceae

Other Common Names: Ozigo, Assia, Igaganga, Ossabel (Gabon), Safoukala (Congo-Brazzaville), Mouguengueri (Zaire).

Distribution: West Africa, prevalent in rain forests.

THE TREE Height variable with species, may reach 120 ft; bole usually straight and cylindrical, most species not buttressed; trunk diameters 2-5 ft.

THE WOOD General Characteristics: Heartwood pink-, gray-buff, or yellowish; not clearly demarcated from the sapwood. Texture moderately fine to coarse; grain straight, wavy, or interlocked; sometimes lustrous; gum ducts and silica present.

Weight: Basic specific gravity (ovendry weight/green volume) variable with species mostly 0.54-0.67; air-dry density 41-51 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	18,600	1,840	10,100
12% (3)	16,500	1,840	8,100
12% (3)	18,600	2,710	8,900

Amsler toughness 128-410 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Generally reported to require careful seasoning to avoid severe degrade due to checking and warping. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.4-7.5%; tangential 5.8-8.2%; volumetric 13.0-15.6%.

Working Properties: Rather difficult to saw because of silica content but generally reported to work fairly well with hand and machine tools; good slicing and peeling characteristics; glues readily and takes a fine finish.

Durability: Heartwood has moderate to low resistance to attack by decay fungi, also liable to termite attack.

Preservation: Generally heartwood resistant to preservative treatments, sapwood moderately resistant.

Uses: Flooring, furniture components, veneer and plywood, joinery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Kryn, J. M., and E. W. Fobes.
1959. The woods of Liberia. USDA Forest Serv. FPL Rpt. No. 2159. Forest Products Laboratory, Madison, Wis.
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DALBERGIA MELANOXYLON

AFRICAN BLACKWOOD

Family: Leguminosae

Other Common Names: Mufunjo (Uganda), Mpingo, Mugembe (Tanzania), Babanus (Sudan), Mukelete (Rhodesia), Grenadilla (Mozambique).

Distribution: A rather extensive range in savanna regions from Sudan southward to Mozambique, westward to Angola, and then northward to Nigeria and Senegal.

THE TREE Much branched, multistemmed small tree usually 15-25 ft high, sometimes as much as 50 ft; bole short, seldom cylindrical, often fluted; rarely over 1 ft in diameter.

THE WOOD General Characteristics: Heartwood dark purplish-brown with black streaking; sharply demarcated from the narrow yellowish sapwood. Texture fine and even; grain straight; luster low; slightly oily.

Weight: Basic specific gravity (ovendry weight/green volume) about 1.08; air-dry density 83 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
12% (4)*	31,000	2,980	10,800

Amsler toughness 435 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Timber must be seasoned very slowly, end coating of logs or billets is necessary. Drying times of 2-3 years and more are common. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: volumetric 7.6%. Movement in service is rated as small.

Working Properties: Sawteeth blunt rapidly, difficult to plane with hand or machine tools. Excellent for turnery and can be worked to a smooth, lustrous finish. Woodwind instruments are machined with metal-working equipment.

Durability: Heartwood is rated as highly durable, moderately resistant to termites, sometimes attacked by borers in the standing trees; sapwood liable to attack by powder-post beetle.

Preservation: No information available, reported to respond to a diffusion treatment of polyethylene glycol-1,000 to improve dimensional stability.

Uses: Used primarily for the manufacture of woodwind instruments, but also used for other turnery work, brush backs, knife handles, walking sticks, inlay work, carvings, etc.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Eggeling, W. J., and C. M. Harris.
1939. Fifteen Uganda timbers. Clarendon Press, Oxford.
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DANIELLIA OGAE
and D. THURIFERA

OGAE

Family: Leguminosae

Other Common Names: Ehyedua, Shedua (Ghana), Oziya, Daniellia (Nigeria), Fara (Ivory Coast), Nsou (Cameroon), Faro (France), Incenso (Portuguese Guinea).

Distribution: West Africa, particularly common in the rain forest of southern Nigeria.

THE TREE Reaches a height of 100-150 ft or more; boles straight, clear, cylindrical 50-100 ft in length; trunk diameters 4-7 ft usually unbuttressed.

THE WOOD General Characteristics: Heartwood pale pinkish- to reddish-brown with occasional darker streaks; sapwood distinct, whitish to straw colored, 4-7 in. wide. Texture rather coarse; grain shallowly interlocked; lustrous; may be somewhat gummy.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.40; air-dry density 31 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	11,800	1,320	6,030
12% (4)	9,650	1,180	5,400

Janka side hardness 710 lb for dry material.
Amsler toughness 116 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with only slight warping and collapse in thick material. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 3.0%; tangential 9.0%; volumetric 11.7%. Movement in service is rated as medium.

Working Properties: Works easily with hand and machine tools, quartersawn material tends to tear in planing and shaping, produces a woolly finish unless tools are kept sharp, nails and glues well.

Durability: Heartwood is rated as perishable and nonresistant to termites; sapwood liable to powder-post beetle attack. Liable to sap stain, log conversion should be rapid.

Preservation: Heartwood and inner sapwood resistant to moderately resistant to preservative treatments; outer sapwood is permeable.

Uses: Core stock for plywood, joinery, general millwork, furniture components, boxes and crates, a decorative veneer can be produced from selected logs. Gum exudates from cracks and wounds in the trunk are used to make a varnish (West African Gum Copal).

ADDITIONAL READING

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DIALIUM DINKLAGEI

EYOUUM

Family: Leguminosae

Other Common Names: Dina (Gabon).

Distribution: West Africa, extending from Guinea to the Congo; sometimes in marshy places.

THE TREE A medium-sized tree to a height of 70 ft with a spreading crown; bole usually with small sharp buttresses; trunk diameter 2-3 ft.

THE WOOD General Characteristics: Heartwood dark pink-brown, dark red, or almost black; sapwood very wide, whitish, clearly demarcated. Texture very fine; grain usually straight; very unpleasant odor when freshly sawn; contains red resin cells and has a high silica content.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65-0.79; air-dry density 50-61 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	15,200	1,930	9,400
12% (2)	27,000	2,500	12,600
12% (2)	20,200	1,970	10,500

Amsler toughness 133-478 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rather slowly, stock should be quartersawn to minimize degrade. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.5-4.6%; tangential 7.8-8.0%; volumetric 11.6-14.0%.

Working Properties: Difficult to work with hand or machine tools, rapid dulling of cutters due to high silica content, dresses and polishes well, glues satisfactorily.

Durability: Heartwood is rated as highly durable.

Preservation: Heartwood is untreatable, sapwood resistant to impregnation.

Uses: Industrial flooring, tool handles, railroad crossties, turnery. Bark and leaves are prepared locally for medicinal uses.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Publ. Centre Tech. For. Trop. No. 23.
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DIDELOTIA BREVIPANICULATA

SAPO

Family: Leguminosae

Other Common Names: Sapo, Bondu (Liberia), Ekop Zing (Cameroon).

Distribution: West Africa in evergreen rain forests.

THE TREE May reach a height of 180 ft, bole clear to 80 ft, straight and cylindrical; trunk diameter usually about 2-3 ft but may reach 4-5 ft, swollen at the base.

THE WOOD General Characteristics: Heartwood light brown to brown, sometimes with a greenish tint on the sapwood boundary; sapwood about 2-in. wide reddish-white to a light brown, clearly differentiated. Texture coarse; grain straight to interlocked; without characteristic odor.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.53; air-dry density 41 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	13,400	1,250	7,600
12% (2)	14,700	1,690	7,450

Amsler toughness 315 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Must be seasoned with care as there is a marked tendency to end-split and check on drying. A mild kiln schedule is reported to give good results.
Shrinkage green to oven-dry: radial 3.8%; tangential 9.0%; volumetric 12.8%.

Working Properties: Works fairly well with hand and machine tools, planes to a good finish but there is some tearing of interlocked grain, glues well, peels and slices well into veneers.

Durability: Heartwood is moderately durable but liable to termite attack.

Preservation: Heartwood resistant to impregnation; sapwood permeable.

Uses: Core stock for plywood and blockboard, decorative veneers, particleboard, furniture components, joinery.

ADDITIONAL READING

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DIOSPYROS SPP.

AFRICAN EBONY

Family: Ebenaceae

Other Common Names: Mgiriti, Msindi (Tanzania), Omenowa (Ghana), Kanran, Nyareti (Nigeria), Kukuo (Gambia).

Distribution: Commercial supplies are mostly from Equatorial West Africa. Forms almost pure groups near riverbanks.

THE TREE May attain a height of 50-60 ft with a trunk diameter of about 2 ft.

THE WOOD General Characteristics: Heartwood uniform jet-black or black-brown or streaked; sapwood pink-colored when freshly cut, darkening to a pale red-brown, very variable in width. Texture very fine; grain straight to slightly interlocked or somewhat curly. Sawdust may cause dermatitis.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.82; air-dry density 63pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	27,400	2,560	13,350
12% (3)	21,200	--	9,350

Janka side hardness 3,220 lb for dry material.
Amsler toughness 280 in.-lb for dry material
(2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: In small dimensions dries fairly rapidly with little tendency to check or warp, may split in log form. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial about 5.5%; tangential about 6.5%.

Working Properties: Heartwood difficult to work with hand and machine tools, has a pronounced dulling effect on tool edges, may pickup in planing if grain is irregular, takes an excellent polish. Good steam-bending properties.

Durability: Heartwood rated as very durable, moderately to highly resistant to termite attack.

Preservation: Heartwood extremely resistant; sapwood moderately resistant to permeable.

Uses: Parts of musical instruments, handles for cutlery and tools, brush backs, carvings, turnery, inlaid work.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
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1960. Les ébènes dans le monde. Bois For. Trop. 72:15-22.

DISTEMONANTHUS BENTHAMIANUS

AYAN

Family: Leguminosae

Other Common Names: Movingui (Gabon), Barré (Ivory Coast), Bonsamdua (Ghana), Eyèn (Cameroon), Ayanran (Nigeria).

Distribution: Widely but sparsely distributed throughout the high forests of West Africa, mainly in Cameroon, Ghana, and Nigeria.

THE TREE Reaches a height of 90-125 ft; bole reasonably straight, clear, and cylindrical; trunk diameters 2.5-4.5 ft over rather thin, weakly developed buttresses.

THE WOOD General Characteristics: Heartwood yellowish to yellow-brown, sometimes with dark streaking; sapwood narrow, whitish or straw colored, fairly distinct. Texture fine; grain often interlocked, sometimes wavy; lustrous; some logs produce a decorative figure; may contain up to 1.3% silica; contains a yellow extractive that may stain fabrics if moistened.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.58; air-dry density 45pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	15,700	1,650	8,310
12% (4)	19,000	--	9,800

Janka side hardness for dry material 1,230 lb.
Amsler toughness 250 in.-lb for dry material
(2-cm specimen).

*See "Additional Reading" for references.

Degradation and Shrinkage: Air-dries well, though slowly, with little degrade. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.1%; tangential 5.2%; volumetric 10.7%. Movement in service is rated as small.

Working Properties: Works fairly readily with machine and hand tools. Blunting effect on cutters varies depending on silica content. Gum buildup on saws causes overheating. Takes a good finish, good gluing properties, easy to peel into veneers, moderately good steam-bending properties.

Durability: Heartwood is rated as moderately durable and moderately resistant to termite attack.

Preservation: Heartwood resistant to impregnation.

Uses: Cabinetwork, joinery, flooring, decorative veneers. It's suggested as an oak alternative.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois For. Trop.
1975. Movingui (Distemonanthus benthamianus). Rev. For. Trop. 162:25-36.
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EKEBERGIA RUEPPELLIANA

EKEBERGIA

Family: Meliaceae

Other Common Names: Ol Mokuna, Msisi (Tanzania), Mufumba (Uganda).

Distribution: Widely distributed in montane forests of East Africa, also found in open grasslands and the coastal savanna belt.

THE TREE Reaches a height of 80-100 ft; with a short bole rarely exceeding 30 ft, heavily fluted, crooked; trunk diameter about 3 ft.

THE WOOD General Characteristics: Wood pinkish when freshly cut, turning whitish or pale brown on drying, sapwood and heartwood not clearly defined. Texture varies from fine to coarse; grain straight; sometimes figured.

Weight: Basic specific gravity (ovendry weight/green volume) 0.50; air-dry density 38pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing
	Psi	1,000 psi	Psi
12% (2)*	8,000	--	4,000

Janka side hardness 900 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly with little degrade apart from moderate cupping. No information on kiln schedules available. Shrinkage green to 12% moisture content: radial 1.7%; tangential 4.3%. Movement in service is rated as medium.

Working Properties: Easy to work with hand and machine tools, dresses to a smooth finish, nails easily but tends to split.

Durability: The wood is vulnerable to attack by decay fungi and termites, susceptible to blue stain.

Preservation: Good permeability is reported.

Uses: Furniture, joinery, figured veneer, plywood, broom and brush handles, a general utility wood.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.

ENTANDROPHRAGMA ANGOLENSE

GEDU NOHOR

Family: Meliaceae

Other Common Names: Mukusu (Uganda), Tiama (Ivory Coast), Edinam (Ghana), Kalungi (Zaire).

Distribution: West, Central, and East Africa; occurs in rain forests, deciduous forests, and transitional formations. Coppices freely at the pole stage.

THE TREE Reaches a height of 160 ft, bole moderately straight, cylindrical, clear to 60-80 ft; trunk diameters 4-7 ft over large buttresses; wide-spreading root ridges.

THE WOOD General Characteristics: Heartwood pink-brown or a dull uniform red, usually darkening on exposure to a deep red-brown; sapwood creamy-white or pale pink, up to 4 in. wide, sometimes not sharply demarcated. Grain interlocked, producing rather broad stripes; texture medium to rather coarse; without taste and almost without odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45; air-dry density 34pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	7,500	1,000	3,680
12%	11,200	1,250	6,550
12% (4)	12,300	1,600	7,400

Janka side hardness 770 lb for green material and 940 lb for dry. Amsler toughness 145 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly but with a marked tendency to warp. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to ovendry: radial 4.7%; tangential 6.6%; volumetric 11.8%. Movement in service is rated as small.

Working Properties: Works rather easily with hand and machine tools, but there is tearing of interlocked grain, otherwise a good finish is obtained in most operations. Good gluing properties.

Durability: Heartwood is rated as moderately durable, termite resistance is variable. Sapwood liable to attack by powder-post beetle.

Preservation: Heartwood is rated as extremely resistant to preservative treatments, sapwood is resistant.

Uses: Furniture, joinery, cabinetmaking, boat construction, decorative veneers and plywood.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Eggeling, W. J., and C. M. Harris.
1939. Fifteen Uganda timbers. Clarendon Press. Oxford.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
4. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

ENTANDROPHRAGMA CANDOLLEI

KOSIPO

Family: Meliaceae

Other Common Names: Omu (Nigeria), Candollei (Ghana).

Distribution: West Africa to Angola and the Congo region; in evergreen, moist, and transitional formations.

THE TREE A large tree to a height of 200 ft with a wide-spreading crown; bole cylindrical, straight and clear to 100 ft; trunk diameters up to 7 ft, buttressed to a height of about 10 ft.

THE WOOD General Characteristics: Heartwood dull brown or purple-brown and clearly demarcated from the whitish to pale brown sapwood. Texture rather coarse; grain generally interlocked; without distinctive odor or taste. This is the only species of Entandrophragma that is reported to contain silica.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52-0.65; air-dry density 40-50pcf.

Mechanical Properties: (First two sets of data based on the 2-cm standard; third set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	13,200	--	7,500
12% (3)	12,300	--	7,500
12% (4)	12,300	1,840	8,450

Amsler toughness 206-228 in.-lb for dry material (2-cm specimen).

Drying and Shrinkage: Dries rather slowly with a marked tendency to warp, good stacking minimizes degrade. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to air-dry: radial 4.0%; tangential 6.0%. Movement in service is rated as medium.

Working Properties: Rather difficult to saw, works readily with hand and machine tools, tends to tear interlocked grain, polishes and finishes well.

Durability: Heartwood moderately durable and moderately resistant to termite attack.

Preservation: Heartwood resistant to preservative treatment; sapwood moderately resistant.

Uses: Joinery, furniture and cabinetwork, flooring, decorative veneers, plywood, boat construction.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Farmer, R. H. (ed.).
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3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.
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1962. Some Nigerian woods. Federal Ministry of Information. Lagos.

ENTANDROPHRAGMA CYLINDRICUM

SAPELE

Family: Meliaceae

Other Common Names: Aboudikro (Ivory Coast), Penkwa (Ghana), Muyovu (Uganda), Sapelli (Cameroon), Libuyu (Zaire).

Distribution: Ranging from the Ivory Coast to the Cameroons and eastward through Zaire to Uganda. Occurs in evergreen, deciduous, and transitional forest formations.

THE TREE May reach a height of 150-200 ft; bole straight and cylindrical, clear to 100 ft; trunk diameters to 6 ft over broad, low buttresses, sometimes not buttressed.

THE WOOD General Characteristics: Heartwood a medium to fairly dark reddish-brown or purplish-brown; sapwood whitish or pale yellow, distinct. Texture rather fine; grain interlocked, sometimes wavy, producing a narrow, uniform, roe figure on quartered surfaces; lustrous; without a distinctive taste but with a cedarlike scent.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.55; air-dry density 42pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	10,700	1,390	5,220
12%	16,100	1,700	8,500
12% (3)	16,500	1,700	8,900

Janka side hardness 1,020 lb for green and 1,500 lb for dry material. Amsler toughness 200 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons fairly rapidly but with a marked tendency to warp, very variable in drying properties, requires careful stacking. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to ovendry: radial 4.6%; tangential 7.4%; volumetric 14.0%. Movement in service is rated as medium.

Working Properties: Works fairly well with hand and machine tools, tends to tear interlocked grain in planing, saws easily, finishes well, good gluing and nailing properties, satisfactory peeling and slicing.

Durability: Heartwood is moderately durable, resistance to termite attack variable. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood resistant; sapwood moderately resistant.

Uses: Furniture and cabinetwork, decorative veneers, plywood, joinery, flooring, paneling.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois For. Trop.
1974. Sapelli (Entandrophragma cylindricum). Bois For. Trop. 154:27-40.

ENTANDROPHRAGMA UTILE

UTILE

Family: Meliaceae

Other Common Names: Efudwe (Ghana), Sipo (Ivory Coast), Okeong (Nigeria), Assié (Cameroon), Kosi-Kosi (Gabon), Mufumbi (Uganda).

Distribution: Principally from West and Central Africa. Occurs in moist deciduous high forests, dry subtypes, and transitional formations. Rather abundant in the Ivory Coast.

THE TREE Grows to a height of 150-200 ft; bole is straight, cylindrical, and clear to 100 ft, occasionally fluted; diameter above buttresses may reach 8 ft.

THE WOOD General Characteristics: Heartwood fairly uniform red- or purple-brown; well demarcated from the light-brown sapwood. Texture medium; grain interlocked and rather irregular, has a less uniform stripe figure than sapele; has a faint cedarlike scent. Timber is corrosive to metals.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.53; air-dry density 41pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,400	1,390	5,540
12%	15,000	1,560	8,760
12% (4)	13,700	1,610	7,900

Janka side hardness 1,080 lb for green material and 1,260 lb for dry. Amsler toughness 144 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air-dries at a slow to moderate rate with a slight to marked tendency to end-check and warp. Kiln dries satisfactorily, usually with only slight degrade; schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to oven-dry: radial 4.6%; tangential 6.4%; volumetric 11.0%. Movement in service is rated as medium.

Working Properties: Works fairly easily with hand and machine tools, interlocked grain may cause tearing in planing and shaping, finishes well, glues and nails easily.

Durability: Heartwood is moderately resistant to attack by decay fungi and termites. Sapwood is liable to attack by powder-post beetle.

Preservation: Heartwood is extremely resistant to treatment; sapwood is easy to treat.

Uses: Furniture and cabinetwork, joinery, decorative veneers and plywood, boat construction.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Eggeling, W. J., and C. M. Harris.
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4. France: Bois For. Trop.
1973. Sipo (Entandrophragma utile). Bois For. Trop. 150:37-48.

ERYTHROPHLEUM IVORENSE
and E. GUINEENSE

MISSANDA

Family: Leguminosae

Other Common Names: Tali (Ivory Coast), Erun, Sasswood (Nigeria), Potrodom (Ghana), Kassa (Zaire), Muave (Zambia), Mwavi (Tanzania).

Distribution: Widely distributed in tropical Africa from the west to east coast. The genus is found in evergreen, deciduous, and savanna forests.

THE TREE Up to 100-140 ft in height; with a bole length of 30-50 ft, usually irregular, often buttressed; trunk diameters 3-5 ft. Seed and bark are poisonous if ingested.

THE WOOD General Characteristics: Heartwood is red-, yellow-, or orange-brown, darkening on exposure, sometimes streaked; sapwood creamy-yellow, distinct. Texture coarse; grain interlocked or irregular; moderately high luster.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.72; air-dry density 56pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	18,000	1,930	10,300
12%	23,500	2,240	14,100
12% (<u>4</u>)	14,400	1,530	8,100
12% (<u>4</u>)	21,800	2,460	11,800

Janka side hardness 2,320 lb for green material and 2,930 lb for dry. Amsler toughness 195-238 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly with some tendency to warp, generally with little degrade. Kiln schedule T3-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 5.8%; tangential 8.6%; volumetric 11.5%. Movement in service is rated as small.

Working Properties: Dry wood is very difficult to saw and machine, rapid blunting of tools, carbide-tipped cutters are suggested; works to a smooth finish and takes a high polish, turns well. Sawdust may cause nose and throat irritation.

Durability: Heartwood is rated as very durable and highly resistant to termite attack. Also described as resistant to marine borers.

Preservation: Heartwood uncreatable; sapwood variable.

Uses: Flooring, heavy construction, railway crossties, harbor and dockwork.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
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1964. Propriétés physiques et mécaniques des bois tropicaux. Publ. Centre Tech. For. Trop. No. 23.

ERYTHROXYLUM MANII

LANDA

Family: Erythroxylaceae

Other Common Names: Bimini (Sierra Leone), Dabé, Ndabé (Ivory Coast), Ditsumi (Gabon), Lukiènzo (Zaire).

Distribution: Somewhat sporadically from Sierra Leone to the Cameroons and inland to the Congo; found in both deciduous and rain forests, mainly in small groups.

THE TREE Reaches a height of about 90 ft; boles variable, sometimes up to 60 ft; trunk diameters 3-4 ft.

THE WOOD General Characteristics: Heartwood pink or red-brown; sapwood gray with a copper sheen. Texture fine, generally even; grain interlocked to irregular; numerous pith flecks forming dark lines 1-2 in. long.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.50; air-dry density 40pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	13,000	--	7,450
12% (3)	15,200	--	8,200

Amsler toughness 282 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons fairly rapidly without checking or warping. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Volumetric shrinkage green to ovendry: 11.6%.

Working Properties: Saws well and works easily with hand and machine tools, dresses well, good gluing and finishing properties, good veneer slicing and peeling properties.

Durability: Heartwood moderately durable but liable to some termite attack. Good weathering properties.

Preservation: Heartwood resistant to impregnation, sapwood moderately resistant.

Uses: General construction, furniture, joinery, veneer and plywood.

ADDITIONAL READING

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1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. France: Rev. Bois Appl.
1957. La page des bois tropicaux. Landa. Rev. Bois Appl. 12(12).
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FAGARA MACROPHYLLA

EAST AFRICAN SATINWOOD

Family: Rutaceae

Other Common Names: Olon dur (Gabon), Munyenye (Uganda).

Distribution: Widely distributed in the equatorial forests, occurring up to elevations of 8,000 ft.

THE TREE Very variable, depending on site, may reach a height of 95-115 ft and more; bole usually straight and cylindrical; trunk diameters 2-5 ft.

THE WOOD General Characteristics: Heartwood bright or pale yellow darkening slightly on exposure; sapwood narrow, somewhat lighter, barely distinguishable. Grain interlocked giving a stripe figure; texture medium to fairly coarse; luster rather high; has a sweet scent when freshly sawn that does not persist.

Weight: Basic specific gravity (ovendry weight/green volume) very variable 0.55-0.83; air-dry density 42-64 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second and third sets on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
			Psi
Green (3)*	11,400	1,570	6,100
12%	15,000	1,990	8,020
12% (2)	29,200	--	15,100
12% (2)	30,800	--	14,100

*See "Additional Reading" for references.

Drying and Shrinkage: Air-seasons rapidly with little degrade, some tendency, though, to warp. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Volumetric shrinkage green to ovendry about 11.5%.

Working Properties: Working characteristics variable, difficult to hand plane, high feed speeds in power sawing are suggested, can be dressed to a good finish, difficult to glue, has good steam-bending properties.

Durability: Not durable, sapwood liable to borer attack.

Preservation: Heartwood is rated as resistant to preservative treatments; sapwood permeable.

Uses: Fine furniture and cabinetwork, flooring, paneling, veneer, turnery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Sallenave, P.
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1957. Fagara macrophylla. Timb. Leafl. For. Dep. Uganda No. 33.

FAGAROPSIS ANGOLENSIS

MAFU

Family: Rutaceae

Other Common Names: Mfu, Mkunguni, Mtongoti (Tanzania),
Muyinja (Kenya).

Distribution: East Africa, found in rain and subtropical
forests to elevations of about 6,000 ft.

THE TREE Total height 70-110 ft; boles 30-60 ft, rarely straight,
cylindrical or oval in cross section; trunk diameters
2.5-3.5 ft.

THE WOOD General Characteristics: Heartwood dark green or brown
tinged with green and yellow, darkening on exposure;
sapwood pale yellow or grayish-white, distinct.
Texture fine and even; grain usually straight but may
be wavy and irregular; lustrous; bitter taste but
without scent; sometimes figured.

Weight: Basic specific gravity (ovendry weight/green
volume) 0.56; air-dry density 43 pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
12% (2)*	15,200	2,100	8,590

Janka side hardness 1,370 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly with little degrade aside from moderate end-checking in thick material. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 2.1%; tangential 3.7%. Movement in service is rated as medium.

Working Properties: Boards often split during log breakdown, saws easily and machines well to a smooth finish, turns readily, poor nailing properties.

Durability: Heartwood is moderately durable and also moderately resistant to termite attack.

Preservation: Heartwood is not treatable; sapwood is permeable, absorptions of about 10pcf of preservative oils can be obtained using either an open-tank or pressure system.

Uses: Fine furniture and cabinetwork, joinery, turnery, inlay work, decorative veneers, paneling.

ADDITIONAL READING

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GAMBEYA AFRICANA
SYN. CHRYSOPHYLLUM AFRICANUM

LONGUI

Family: Sapotaceae

Other Common Names: Longui rouge (Congo-Brazzaville).

Distribution: From Sierra Leone to the Congo region and Angola; found in rain forests and transitional formations, often planted for its edible fruits.

THE TREE May reach a height of 70-100 ft; bole up to 40 ft in length, straight, usually fluted, low buttresses; trunk diameters up to 4 ft.

THE WOOD General Characteristics: Heartwood whitish when first felled, turning a pink-buff to an olive-yellow, and finally a yellowish-brown; not demarcated from the sapwood. Texture fine to medium; grain straight to occasionally interlocked; luster rather low; wood contains a pale-brown gum.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.63; air-dry density 48 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	18,700	2,300	9,850
12% (2)	18,200	1,820	10,700

Amsler toughness 240 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Most species of this genus season well with little or no degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 5.8%; tangential 8.1%; volumetric 14.0%.

Working Properties: Easy to saw, machines well and dresses to a smooth finish, does not split in nailing, good gluing properties; peels and slices satisfactorily.

Durability: Durability low and prone to termite attack.

Preservation: Treatable by pressure processes.

Uses: General construction, flooring, furniture components, veneer and plywood, joinery. Seeds produce an edible oil.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Sallenave, P.
1964. Propriétés physiques et mécaniques des bois tropicaux. Publ. Centre Tech. For. Trop. No. 23.

GONIOMA KAMASSI

KAMASSI

Family: Apocynaceae

Other Common Names: Cape boxwood, Kamassihout, Knysna boxwood, Kamassi boxwood (South Africa).

Distribution: Confined mainly to the midland coastal districts of South Africa.

THE TREE Usually about 20 ft in height; bole seldom over 10 ft in length; trunk diameter about 1 ft.

THE WOOD General Characteristics: Wood a uniform yellow or yellow brown, heartwood and sapwood not clearly defined. Texture exceptionally fine and even; grain straight, no figure; odor is lacking, but with a bitter taste. Fine dust may cause headaches, giddiness, skin inflammation, and asthma.

Weight: Basic specific gravity (ovendry weight/green volume) 0.75; air-dry density 58 pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (1)*	20,970	2,543	10,530

Janka side hardness 2,730 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons well if dried slowly, otherwise surface and end-checking can be severe. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkages are reported to be high.

Working Properties: Sawing satisfactory with only a moderate blunting effect, not too difficult to work with hand tools, works to an excellent finish in most operations, turns exceptionally well.

Durability: Reported to be durable in ground contact but also reported to be liable to staining.

Preservation: Extremely resistant to impregnation.

Uses: Precision instruments, fancy turnery, engravers' work, shuttles, small tool handles.

ADDITIONAL READING

1. Banks, C. H.
1954. The mechanical properties of timbers with particular reference to those grown in the Union of South Africa. Jour. South African For. Assoc. 24:44-65.
2. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO, Div. of Build. Res. Melbourne, Australia.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

GOSSWEILERODENDRON BALSAMIFERUM

AGBA

Family: Leguminosae

Other Common Names: Achi, Egba, Emongi (Nigeria), Tola blanc (Congo-Brazzaville), Tola branca (Angola), N'Tola (Zaire).

Distribution: Tropical West Africa from Nigeria southwards to the Congo basin, scattered or in local pockets, favoring deep soil and plenty of moisture.

THE TREE Reaches a height of 200 ft; boles clear and straight to 80-100 ft and more; trunk diameters 5-8 ft. Trunk wounds yield a thick gummy exudate.

THE WOOD General Characteristics: Heartwood yellowish- to pinkish-brown, darkening on exposure; sapwood 4 in. wide, slightly lighter in color, not well demarcated. Texture moderately fine and even; grain straight to slightly wavy or interlocked; luster high; resinous odor; large resin deposits may accumulate in shakes near the heart.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.40; air-dry density 30pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (2)*	7,500	870	3,520
12%	11,800	1,100	6,270
12% (4)	9,500	920	4,800

Janka side hardness 620 lb for green material and 740 lb for dry. Amsler toughness 106 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with very little tendency to warp or check. Boards must be separated by stickering immediately after sawing to prevent resin exudates sticking them together. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to 12% moisture content: radial 1.5%; tangential 3.0%. Movement in service is rated as small.

Working Properties: Saws readily and works easily with hand and machine tools, gums may collect on sawteeth and cutters, good gluing properties, moderately good steam-bending characteristics.

Durability: Heartwood is rated as durable, fairly resistant to termite attack.

Preservation: Heartwood resistant to impregnation; sapwood permeable.

Uses: A general purpose timber, furniture, joinery, boat-building, light construction, millwork, corestock, plywood, domestic flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois For. Trop.
1953. Agba (Gossweilerodendron balsamiferum). Bois For. Trop. 29:17-20.
4. Sallenave, P.
1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Publ. Centre Tech. For. Trop. No. 23.

GUAREA CEDRATA
and G. THOMPSONII

GUAREA

Family: Meliaceae

Other Common Names: Bossé (Ivory Coast), Kwabohoro (Ghana), Obobo (Nigeria), Édoucié (Cameroon).

Distribution: The range of both species overlaps in Ivory Coast, Ghana, and southern Nigeria. G. cedrata extends into the Cameroons, G. thomssonii reaches into Liberia.

THE TREE Reaches a height of 160 ft; boles are long, straight, and cylindrical; trunk diameters are about 3-4 ft above buttresses.

THE WOOD General Characteristics: Heartwood pinkish-brown, darkening on exposure; sapwood variable in width, pale in color, often well demarcated. Texture medium to fine; grain straight, wavy, or interlocked; lustrous; both woods contain gums. Silica often present in G. cedrata. Cedar odor sometimes persists. Dust may irritate skin and mucous membranes.

Weight: Basic specific gravity (ovendry weight/ green volume) about 0.48; air-dry density 36 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	10,800	1,290	5,140
12%	14,900	1,370	7,720
Green (2)	12,400	1,540	6,260
12%	15,500	1,570	8,680
12% (3)	14,700	--	7,750

Janka side hardness about 1,000 lb for dry material. Amsler toughness 230 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with little tendency to warp, may require some care to prevent checking. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial 2.0-2.5%; tangential 3.5-4.0%. Movement in service is rated as small.

Working Properties: Works fairly well with hand and machine tools, some picking of grain if interlocked, slight to moderate blunting of cutters, glues well, takes a good polish, good to moderately good steam-bending properties. Sometimes difficult to handle because of gum. Dust may be irritating.

Durability: Heartwood ratings vary from durable to moderately durable; moderately resistant to termite attack.

Preservation: Heartwood highly resistant to impregnation; sapwood permeable.

Uses: Furniture, joinery, paneling, boatbuilding, decorative veneers, turnery, flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

GUIBOURTIA ARNOLDIANA

MUTENYE
BENGÉ

Family: Leguminosae

Other Common Names: Bengé, Mbenge (Zaire).

Distribution: West Central Africa.

THE TREE Reaches a height of about 75-100 ft; bole irregular, to 60 ft in length; trunk diameters to 3 ft; usually buttressed.

THE WOOD General Characteristics: Heartwood pale yellowish-brown to medium brown, sometimes with a reddish tinge, with gray to almost black striping; sapwood dull gray with a yellowish cast, distinct. Texture moderately fine and fairly even; grain straight to interlocked, sometimes wavy; highly figured. Included phloem and gum pockets sometimes present.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.64; air-dry density 50 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	21,400	2,040	11,400
12% (3)	22,300	3,100	12,200

Amsler toughness 244-510 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to season well if care is taken, though liable to some warping and checking. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.6-5.8%; tangential 8.0-9.2%; volumetric 10.5-14.7%. Movement in service is rated as medium.

Working Properties: Through hard and heavy, works well with hand and machine tools, picking of interlocked grain in planing, veneers well but bolts must be preheated. Reported that silica may cause rapid dulling of cutters, but also reported to be nonsiliceous.

Durability: Heartwood reported to be moderately durable and moderately resistant to termite attack.

Preservation: Heartwood resistant to preservative treatments; sapwood is moderately resistant.

Uses: Turnery, flooring, furniture components, decorative veneer.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

GUIBOURTIA EHIE

OVANGKOL
AMAZOUE

Family: Leguminosae

Other Common Names: Ehie, Anokye (Ghana), Amazoué, Amazakoué (Ivory Coast). Currently being marketed in the U.S.A. as "Mozambique."

Distribution: Ivory Coast, Ghana, Southern Nigeria, and Gabon. Prefers closed rain forests and transitional forests, often in small groups.

THE TREE Reaches a height of 100-150 ft; boles straight, cylindrical, up to 70 ft in length; trunk diameters 2-3 ft over buttresses.

THE WOOD General Characteristics: Heartwood yellow-brown to dark brown with gray to almost black stripes; sapwood yellow-white, about 4 in. wide, clearly demarcated. Texture moderately coarse; grain straight to interlocked; attractive figure; unpleasant odor when freshly cut.

Weight: Basic specific gravity (ovendry weight/green volume) 0.67; air-dry density 52 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	20,000	2,540	8,950
12% (3)	15,500	2,250	8,300

Amsler toughness 330 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Requires care in seasoning. No information on kiln schedules. Shrinkage green to ovendry: radial 3.6-5.3%; tangential 6.6-9.8%; volumetric 10.0-12.0.

Working Properties: Saws slowly but well for its density, works fairly easily with hand and machine tools, planes to a good finish, must be heated before slicing into veneers. May stain when in contact with metal.

Durability: Heartwood moderately durable, rarely attacked by termites.

Preservation: Heartwood resistant to impregnation; sapwood moderately resistant.

Uses: Fine furniture and cabinetwork, turnery, decorative veneers, flooring. A walnutlike wood. Yields a gum copal used in pharmaceuticals and as a base for varnishes.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

GUIBOURTIA spp.

BUBINGA

Family: Leguminosae

Other Common Names: Essingang (Cameroon), Ovang, Kevazingo (Gabon), Waka (Zaire).

Distribution: The species in this group are found in Equatorial Africa from Southeast Nigeria, through Cameroon and Gabon to the Congo region. Occur in swampy or periodically inundated forests, also near river or lakeshores.

THE TREE Reaches a height of 130-150 ft; boles are straight and cylindrical to 70 ft, sometimes fluted or buttressed; trunk diameters 3-6 ft.

THE WOOD General Characteristics: Heartwood pink, vivid red, or red-brown with purple streaks or veins, on exposure becomes yellow or medium brown with a reddish tint, veining becomes less conspicuous; sapwood whitish and clearly demarcated. Texture fine and even; grain straight or interlocked; lustrous; sometimes highly figured; has an unpleasant odor when first cut which disappears on drying.

Weight: Basic specific gravity (ovendry weight/green volume) mostly 0.65-0.78; air-dry density 50-60 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (4)*	33,500	3,470	13,000
12% (4)	22,600	2,480	10,500
12% (3)	19,200	2,200	9,600

Amsler toughness 222-605 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Timber must be seasoned slowly to avoid distortion and checking. Kiln schedule T2-C2 may be suitable for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 4.0-7.6%; tangential 6.6-10.2%; volumetric 9.4-16.6%.

Working Properties: Though quite hard and heavy the species work, saw, and plane rather well and produce a good finish, glues well, a good wood for turnings.

Durability: Heartwood has good durability and is resistant to termite attack. Moderately resistant to marine borers.

Preservation: Heartwood resistant to impregnation; sapwood moderately resistant.

Uses: Some resemblance to rosewood. Fine furniture and cabinetwork, decorative veneers, fancy turnery, inlay work.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timber--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Publ. Centre Tech. For. Trop. No. 23.
4. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

HOMALIUM SPP.

AFRICAN HOMALIUM

Family: Flacourtiaceae

Other Common Names: Melefoufou (Ivory Coast), Bro-kpah (Liberia).

Distribution: Tropical West Africa from Guinea to Gabon, mainly in the dense rain forests.

THE TREE Reaches a height of 80-100 ft, boles straight and clear, sometimes with low buttresses on a swollen base; trunk diameter 2 ft.

THE WOOD General Characteristics: Wood yellowish-white, sometimes with darker stripes; heartwood and sapwood not differentiated. Texture fine; grain straight or interlocked; dull.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 54 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	18,100	2,170	9,000
12% (3)	18,500	2,640	10,100

Janka side hardness 2,050 lb for dry material.
Amsler toughness 178 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to require very careful seasoning. No information on kiln schedules. Shrinkage green to oven dry: radial 7.0%; tangential 9.6%; volumetric 17.2%.

Working Properties: Easy to saw, plane, and finish but hardened cutters are required. Rapid blunting may occur due to the presence of silica. Good steam-bending characteristics.

Durability: Wood is moderately durable; fairly resistant to marine borer attack. Good weathering properties.

Preservation: Heartwood moderately resistant to impregnation; sapwood permeable.

Uses: Heavy construction, flooring, boatbuilding, railroad crossties, poles and piles.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Lavers, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

IRVINGIA GABONENSIS

OBA

Family: Irvingiaceae

Other Common Names: Bobo (Sierra Leone), Boboru, Wanini (Ivory Coast), Andok (Cameroon), Meba, Mueba (Zaire), Oro, Oba (Nigeria).

Distribution: Western tropical Africa from Senegal to Angola; often found near riverbanks and reaches its optimum in the dense evergreen rain-forest.

THE TREE A deciduous tree reaching a height of 100 ft; bole usually straight and cylindrical, slightly buttressed; trunk diameter 3-5 ft.

THE WOOD General Characteristics: Heartwood pale green-brown or orange-yellow, fading on exposure to a gray-brown, sometimes with dark gray streaks; sapwood lighter, not always differentiated. Texture fine to medium; grain straight to interlocked; without luster.

Weight: Basic specific gravity (ovendry weight/green volume) 0.67-0.75; air-dry density 52-58 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	23,600	2,710	11,400

Amsler toughness 288 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Logs should be converted soon after felling, preferably by quartersawing, to avoid end and surface checking. No information on kiln schedules. Shrinkage green to ovendry: radial 6.8%; tangential 11.4%; volumetric 18.0%.

Working Properties: Moderately difficult to saw and plane, tool edges must be kept sharp, dresses to a smooth finish, glues well.

Durability: Heartwood is durable with little or no termite attack. Good weathering properties.

Preservation: Heartwood is untreatable; sapwood is resistant to preservative treatments.

Uses: Heavy construction, railroad crossties. The tree yields the dika nut, has an edible fruit somewhat like a mango, and kernels that are a source of edible fats.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Chalk, L., et al.
1933. Twenty West African timber trees. Clarendon Press. Oxford.
3. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

ISOBERLINIA SCHEFFLERI

MBARIKA

Family: Leguminosae

Other Common Names: None.

Distribution: Common in the rain forests of the East Usambara mountains in Tanzania.

THE TREE May reach a height of 160 ft with a bole length of 60 ft, buttressed to 12 ft; trunk diameters 4-5 ft. Stems often galleried by the larvae of a Prosopocera borer.

THE WOOD General Characteristics: Heartwood reddish-brown with irregular darker and lighter bands; sapwood 3-4 in. wide, whitish, well differentiated. Texture coarse; grain straight or slightly wavy; green timber has an unpleasant odor; veins exude a grayish gum on freshly-cut cross sections.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65; air-dry density 50pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	14,900	2,120	8,180

Janka side hardness 1,420 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons rather slowly with negligible checking but there is moderate degrade due to bow and spring. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to air-dry: radial 2.5%; tangential 5.9%. Movement in service is rated as medium.

Working Properties: Saws and machines well and dresses to a smooth finish. Machined timber tends to distort during storage due to residual stresses after drying.

Durability: Heartwood is nondurable and not resistant to termite attack.

Preservation: Heartwood is rated as resistant to preservative treatments; sapwood is moderately resistant.

Uses: Heavy construction, flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Tanzania: Util. Div. For. Dep.
1963. Timbers of Tanganyika: Isoberlinia scheffleri (Mbarika). Util. Sec. For. Div. Moshi.

JULBERNARDIA GLOBIFLORA

MUWA

Family: Leguminosae

Other Common Names: Mchenga, Mgombo, Msima (Tanzania).

Distribution: Zambia and Tanzania, widespread in the savanna woodlands.

THE TREE Total height to 40 ft; boles 8-20 ft; trunk diameters 1.5-3 ft; commonly contains ring shake.

THE WOOD General Characteristics: Heartwood dark red-brown, lighter towards the periphery; sapwood pale yellowish brown, 3-6 in. wide, distinct. Texture medium to coarse; grain strongly interlocked to irregular; lustrous.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.78; air-dry density 60 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 fsi	Psi
12% (3)*	21,300	2,260	11,700

Janka side hardness 2,470 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries slowly with a strong tendency to warp; surface and end checking moderate. No information on kiln schedules. Shrinkage green to 12% moisture content: radial 2.9%; tangential 3.6%. Movement in service rated as medium.

Working Properties: Difficult to work with hand and machine tools, rapid blunting of cutters, grain tears in planing and molding, slow feed speeds are suggested, unsatisfactory for turning, moderate steam-bending properties.

Durability: Heartwood is rated as durable but liable to termite attack. Sapwood susceptible to attack by powder-post beetles.

Preservation: Heartwood is untreatable; permeability of sapwood variable, outer zone most permeable.

Uses: Heavy construction, mining timbers, railroad crossties.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.

JUNIPERUS PROCERA

AFRICAN PENCIL CEDAR

Family: Cupressaceae

Other Common Names: Ol tarakwa, Mtarakwa, Mwangati (Tanzania).

Distribution: East Africa; mainly in Kenya, Tanzania, and Uganda; found in the upland evergreen forests at elevations of 6,000-9,000 ft.

THE TREE Reaches a height of 100-120 ft; bole is tapered with a fluted base; trunk diameters mostly 4-5 ft but may reach 10 ft.

THE WOOD General Characteristics: Heartwood pale red, yellow-brown, or purple-red, becoming a warm red-brown on exposure; sapwood narrow, whitish, clearly differentiated. Texture fine; grain straight; quartersawn boards have an attractive figure; noticeable cedar scent. Spiral grain, ingrown bark, and compression wood are common.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.48; air-dry density 36pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,100	1,280	5,800

Janka side hardness 765 lb for green material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries moderately rapidly but in larger sizes tends to surface and end check. Kiln schedule T8-B3 is suggested for 4/4 stock and T5-B1 for 8/4. Shrinkage green to 12% moisture: radial 2.0%; tangential 3.0%.

Working Properties: Works easily with hand and machine tools; being fissile it tends to break and chip in drilling and mortising; glues well, takes an excellent polish; liable to split in nailing.

Durability: Heartwood is classified as durable and resistant to most forms of insect attack.

Preservation: Heartwood is extremely resistant to impregnation; sapwood is permeable.

Uses: Slats for pencil manufacture, furniture, joinery, cabinetwork, tanks and vats, shingles, millwork. Cedarwood oil is distilled from the sawdust.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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1966. Timbers of Tanganyika: Juniperus procera (African Pencil Cedar). Util. Sec. For. Div. Moshi.
3. UK: Dept. Sci. Ind. Res.
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KHAYA GRANDIFOLIOLA
and K. SENEGALENSIS

AFRICAN MAHOGANY
BENIN MAHOGANY
SENEGAL MAHOGANY

Family: Meliaceae

Other Common Names: Diala-iri (Ivory Coast, Ghana), Akuk, Ogwango (Nigeria), Eri Kirée (Uganda), Bandoro (Sudan). Often marketed together with K. ivorensis and K. anthotheca.

Distribution: West tropical Africa from the Guinea Coast to Cameroon and extending eastward through the Congo basin to Uganda and parts of Sudan. Often found in the fringe between the rain forest and the savanna.

THE TREE Reaches a height of 100-130 ft, boles sometimes twisted or crooked with low branching; trunk diameters above buttresses 3-5 ft.

THE WOOD General Characteristics: Heartwood fairly uniform pink to red-brown darkening to a rich mahogany brown; sapwood is lighter in color, not always sharply defined. Texture moderately coarse; grain straight, interlocked, or irregular; without taste or scent.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.55-0.65; air-dry density 42 to 50 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,000	1,320	5,200
12%	14,100	1,540	8,000
12% (4)	13,800	--	8,200

Janka side hardness 1,170 lb for green and 1,350 lb for dry material. Amsler toughness 190 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rather slowly but fairly well with little checking or warp. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to 12% moisture content: radial 2.5%; tangential 4.5%. Movement in service is rated as small.

Working Properties: Good working properties with hand and machine tools. Material with irregular grain difficult to dress to a smooth surface. Turns well, good nailing and gluing properties.

Durability: Heartwood moderately durable; trees and logs liable to attack by longhorn and buprestid beetles; resistant to termites. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood moderately resistant.

Uses: Furniture and cabinetwork, joinery, shop fixtures, flooring, boatbuilding, decorative veneers.

ADDITIONAL READING

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KHAYA IVORENSIS
and K. ANTHOTHECA

AFRICAN MAHOGANY

Family: Meliaceae

Other Common Names: Often further classified as to port of shipment or country of origin; consignments to U.S. trade mostly K. ivorensis. Munyama (Uganda), Acajou d'Afrique (Ivory Coast), Dubini, Dukuma fufu (Ghana), Ogwango (Nigeria).

Distribution: Sierra Leone and Liberia to Gabon. K. anthotheca then extends eastward to Uganda and inhabits lower rainfall regions than K. ivorensis.

THE TREE Reaches heights of 180-200 ft; boles are straight, cylindrical, and clear to 90 ft; trunk diameters are 3-6 ft, buttressed.

THE WOOD General Characteristics: Heartwood light pinkish-brown darkening upon exposure to reddish-brown; sapwood whitish or yellowish, not always sharply demarcated. Texture medium to coarse; grain straight to interlocked, producing a stripe figure; lustrous. Brittleheart present in some logs. Dust from K. anthotheca may be a skin irritant.

Weight: Basic specific gravity (ovendry weight/green volume) 0.44; air-dry density 32pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	7,700	1,080	3,680
12%	12,000	1,310	6,430
Green (2)	7,800	1,080	3,890
12%	11,300	1,300	6,730
12% (3)	10,000	--	6,850

Janka side hardness 640-735 lb for green material and 830-860 lb for dry. Amsler toughness 178 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly with little degrade.

If tension wood is present, serious distortion may occur during drying. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.2%; tangential 5.6%. Movement in service is rated as small.

Working Properties: Rather variable, tends to woolliness and torn grain, sharp thin-edge cutters are suggested, a cutting angle of 20 degrees in planing is recommended. Nailing and gluing properties are good, an excellent finish is readily obtainable. Easy to slice and peel.

Durability: Heartwood is rated as moderately durable, prone to buprestid and termite attack. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood moderately resistant.

Uses: Furniture and cabinetwork, boatbuilding, joinery, veneer and plywood, paneling, shop fixtures.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
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KLAINEDOXA GABONENSIS

EVEUSS

Family: Irvingiaceae

Other Common Names: Kroma (Ivory Coast), Odudu (Nigeria), Mucuttu (Uganda).

Distribution: From Guinea to the Congo Basin, Uganda, and Sudan; occurs in evergreen forests on sandy soil.

THE TREE Reaches a height of 160 ft; bole straight, generally cylindrical and clear to 100 ft; trunk diameters 3-6 ft over thin and high buttresses.

THE WOOD General Characteristics: Heartwood orange-yellow or golden-brown, turning on exposure to a dark brown with black veining; sapwood not clearly demarcated. Texture fine to medium; grain straight to interlocked; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.87; air-dry density 68pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	26,000	3,520	13,100
12% (2)	27,400	3,030	12,600

Amsler toughness about 400 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to be difficult to season and not stable after drying. No information on kiln schedules. Shrinkage green to ovendry: radial 6.6%; tangential 10.0%; volumetric 16.0%.

Working Properties: Saws reasonably well; difficult to work with hand tools, but works rather easily with machine tools. Dresses to a smooth finish.

Durability: Heartwood highly durable, immune to termite attack.

Preservation: Sapwood and heartwood resistant to impregnation.

Uses: Heavy durable construction, factory flooring, mine timbers, railroad crossties, tool handles.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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LOPHIRA ALATA

EKKI
AZOBÉ

Family: Ochnaceae

Other Common Names: Bongossi, Bakundu (Cameroon), Kaku (Ghana), Esore (Ivory Coast), Aba (Nigeria), Endwi (Sierra Leone).

Distribution: West Africa and extending into the Congo Basin; occurs in evergreen and moist deciduous forests, in freshwater swamp forests, and close to riverbanks.

THE TREE May attain a height of 160 ft with a long clear bole to 100 ft; trunk diameters 5-6 ft; without buttresses but lower portion of the bole sometimes swollen.

THE WOOD General Characteristics: Heartwood dark red, chocolate-brown, or purple-brown with conspicuous white deposits in the vessels; sapwood up to 2 in. wide, pale pink, well defined. Texture coarse; grain usually interlocked; luster low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.90; air-dry density 70 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	17,800	2,010	9,920
12%	25,800	2,450	13,120
12% (4)	33,200	3,180	15,200

Janka side hardness 2,900 lb for green material and 3,350 lb for dry. Amsler toughness 625 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Very difficult to season without excessive degrade, particularly surface and end checking; dries slowly. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 8.4%; tangential 11.0%; volumetric 17.0%. Movement in service is rated as medium.

Working Properties: Very difficult to work with hand and machine tools; severe blunting effect if machined when dry; can be dressed to a smooth finish; gluing properties usually good.

Durability: Heartwood is rated as very durable but only moderately resistant to termite attack. Resistant to acids. Good weathering properties. Resistant to teredo attack.

Preservation: Heartwood is rated as extremely resistant to preservative treatments and the sapwood resistant.

Uses: Heavy durable construction work, harbor work, heavy-duty flooring, parquet flooring, railroad crossties.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Chalk, L., et al.
1933. Twenty West African timber trees. Clarendon Press. Oxford.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
4. Sallenave, P.
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LOVOA TRICHILIOIDES
SYN. L. KLAINEANA

AFRICAN-WALNUT
LOVOA
TIGERWOOD

Family: Meliaceae

Other Common Names: Mpengwa (Ghana), Anamemila, Apopo, Sida (Nigeria), Bombulu (Zaire), Dibétou (Gabon, Ivory Coast), Congowood, Tigerwood (USA).

Distribution: West Tropical Africa from Sierra Leone to Gabon; occurs in evergreen and deciduous forests, preferring moist sites, tends to be gregarious.

THE TREE May attain a height of 150 ft; boles straight and cylindrical, clear to 60-90 ft; trunk diameters to 4 ft above short buttresses.

THE WOOD General Characteristics: Heartwood yellowish-brown, sometimes marked with dark streaks or veins; sapwood buff or light gray, narrow, clearly demarcated. Texture fine to medium; grain usually interlocked with an attractive ribbon figure; lustrous; cedarlike scent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45; air-dry density 34 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	8,200	1,060	4,320
12%	11,900	1,340	6,990
12% (4)	12,600	--	6,400

Janka side hardness 690 lb for green material and 940 lb for dry. Amsler toughness 195 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with little degrade, existing heart shake may extend. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial about 2.0%; tangential about 5.0%. Movement in service is rated as small.

Working Properties: Easy to work but sharp tools are required to avoid tearing, particularly when machining quarter-sawn faces. Good gluing properties, moderate steam-bending properties.

Durability: Heartwood is rated as moderately durable, liable to dry-wood termite attack. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is rated as extremely resistant to preservative treatments; sapwood is moderately resistant.

Uses: Furniture and cabinetwork, decorative veneers, paneling, joinery, shop fixtures, gunstocks.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Chalk, L., et al.
1933. Twenty West African timber trees. Clarendon Press. Oxford.
3. Farmer, R. H. (ed.).
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MAESOPSIS EMINII

MUSIZI

Family: Rhamnaceae

Other Common Names: Muhumula, Musira (Tanzania), Muhongera, Muguruka (Uganda), Muhunya (Kenya), Manasati (Ivory Coast).

Distribution: Occurs in Western, Central, and Eastern Africa along the equator. Typically a forest-edge species. Plantations have been established in Zaire and Uganda.

THE TREE Usually 90-120 ft high, bole straight and cylindrical, clear to 60 ft; buttresses or root swellings short and blunt; trunk diameters 4-6 ft. Size of tree decreases across Africa from east to west. In Nigeria trees are seldom over 50 ft in height.

THE WOOD General Characteristics: Heartwood bright yellow-green or green-brown turning to a golden brown on exposure; sapwood nearly white, wide, clearly demarcated. Grain typically interlocked producing a ribbon figure; texture medium to coarse; without characteristic odor or taste when dry. Pin knots sometimes present, rather knotty near the core.

Weight: Basic specific gravity (ovendry weight/green volume) 0.41 (plantation-grown material 0.35); air-dry density 30 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	8,000	1,170	4,140
12%	11,000	1,340	6,670
Green (2)	5,400	950	3,020
12%	8,200	1,140	5,000

Janka side hardness 460-680 lb for green material and 500-700 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with some warp but no surface or end checking. Logs may split full length, though, in felling and storage. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to 12% moisture content: radial 2.5%; tangential 4.0%. Movement in service is rated as small.

Working Properties: Saws and machines very easily and works well with hand tools; planes to a smooth finish if knives are kept sharp; must be supported when drilling and mortising; good gluing and nailing characteristics; difficult to finish because of high absorbency.

Durability: Heartwood readily attacked by decay fungi and termites.

Preservation: Heartwood and sapwood generally rated as permeable.

Uses: Light construction, boxes and crates, millwork, plywood or core stock. Valued as a softwood substitute. The bark is used in the Congo region as a roofing material.

ADDITIONAL READING:

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Eggeling, W. J., and C. M. Harris.
1939. Fifteen Uganda timbers. Clarendon Press. Oxford.
4. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

MAMMEA AFRICANA

OBOTO

Family: Guttiferae

Other Common Names: Bompegya (Ghana), Kaikumba (Liberia, Sierra Leone), Ologbomodu (Nigeria), Aborzok (Cameroon), Bokoli (Zaire).

Distribution: Found in mixed deciduous forests from Sierra Leone to Angola and Zaire, prefers rather wet environment and sometimes forms small stands on flood plains.

THE TREE Up to 120 ft in height; bole straight and cylindrical and may be clear to 50 ft; trunk diameters to about 3 ft; base of trunk is swollen and more or less lobed.

THE WOOD General Characteristics: Heartwood dark red or red-brown, darkening to a mahogany color; sapwood light or pink-brown, well demarcated. Speckled with horizontal gum ducts. Texture somewhat coarse; grain straight to interlocked; without luster; odor or taste not characteristic.

Weight: Basic specific gravity (ovendry weight/green volume) 0.53-0.70; air-dry density 41-54 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	23,300	2,080	11,200
12% (2)	20,100	2,120	9,900

Amsler toughness 122-262 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Difficult to season, must be dried slowly and carefully to avoid collapse and honeycomb. No information on kiln schedules. Shrinkage green to oven-dry: radial 6.5%; tangential 10.0%; volumetric 14.1%. Reported to be rather unstable after manufacture.

Working Properties: Saws cleanly and works well but mineral matter in the vessels tend to blunt cutters. Appreciable quantities of gum are exuded if veneers are hot-pressed into plywood. Takes a fine finish.

Durability: Heartwood is reported to have good decay resistance but is moderately susceptible to termite attack.

Preservation: Resistant to preservative treatments.

Uses: Furniture components, joinery, millwork, general carpentry. Considered as a mahogany substitute.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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MANSONIA ALTISSIMA

MANSONIA

Family: Sterculiaceae

Other Common Names: Aprono (Ghana), Bété (Ivory Coast), Ofun (Nigeria), Koul (Cameroon).

Distribution: Occurs in the deciduous forest type from Ivory Coast to Cameroon.

THE TREE Reaches a height of 120 ft; bole clear and straight, buttressed, up to 60 ft in length; trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood yellow-brown or dark gray-brown, frequently with a purplish cast, often shows light and dark bands; sapwood whitish, sharply demarcated. Texture fine to medium; grain generally straight; luster low to medium. Resembles American black walnut. Lacks a distinct odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.50-0.58; air-dry density 33-45 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	13,000	1,400	6,400
12%	17,700	1,580	8,500
12% (3)	17,200	1,680	7,750
12% (3)	14,900	1,450	7,150

Janka side hardness 1,210 lb for green and 1,290 lb for dry wood. Amsler toughness 150-324 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with little degrade but knots tend to split and shake tends to extend. Kiln schedule T10-D4S is suggested for 4/4 stock and T3-D3S for 8/4. Shrinkage green to ovendry: radial 4.4%; tangential 7.3%; volumetric 10.2%. Movement in service is rated as medium.

Working Properties: Works easily with hand and machine tools with little dulling of cutters, has good nailing and gluing properties, rated as a good steam-bending wood. Sawdust may cause nose and throat irritation.

Durability: Heartwood is very durable and highly resistant to termite attack.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood is permeable.

Uses: High quality cabinet and furniture work, joinery, turnery, decorative veneers. Bark contains a cardiac poison of the digitalis group. Used as an alternate for walnut.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
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MICROBERLINIA BRAZZAVILLENSIS

ZEBRANO

ZEBRAWOOD

Family: Leguminosae

Other Common Names: Zingana (Gabon), Allen élé (Cameroon).

Distribution: West Africa, mainly in Gabon and Cameroon, gregarious, sometimes in pure stands along riverbanks.

THE TREE A tall tree to 150 ft; bole straight and cylindrical but relatively short, up to 50 ft; trunk diameters 4-5 ft over low buttresses.

THE WOOD General Characteristics: Heartwood pale yellow-brown with narrow darker streaks, striping pattern varies considerably; sapwood white up to 4 in. wide, distinct. Texture medium to coarse; grain usually wavy or interlocked; lustrous; unpleasant odor disappears after drying.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.70; air-dry density 53 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
12% (2)*	17,200	--	8,500
12% (3)	22,800	2,340	10,700

Amsler toughness 550 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Difficult to season without warping, should be quartersawn to minimize degrade. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 6.8%; tangential 11.5%; volumetric 16.5%.

Working Properties: Saws fairly well, a clean smooth finish is sometimes difficult to obtain with machine or hand planing, tearing of interlocked grain; good gluing properties, veneers need careful handling to avoid cracking.

Durability: Heartwood is durable and resistant to termite attack.

Preservation: Heartwood extremely resistant; sapwood permeable.

Uses: Decorative veneers, turnery. Because of high toughness, used in ski manufacture, tool handles, etc.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.
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MILLETTIA spp.

PANGA PANGA

WENGE

Family: Leguminosae

Other Common Names: Millettia laurentii: Wenge (Zaire), Awong (Cameroon). Millettia stuhlmannii: Panga panga, Mpande (Tanzania).

Distribution: Southern regions of Tanzania and Mozambique, found in open forests. Wenge occurs in the Congo region in periodically inundated swampy forests.

THE TREE Varies with species, about 60-90 ft; bole usually straight and unbuttressed; trunk diameters 3-4 ft.

THE WOOD General Characteristics: Heartwood dark brown to almost black with alternate layers of light and dark tissue forming a decorative figure; sapwood yellowish-white, clearly demarcated. Texture rather coarse; grain straight.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65-0.78; air-dry density 50-60 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second and third sets on the 2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	16,200	1,970	9,950
12% (4)	28,400	2,530	14,500
12% (3)	17,700	--	10,200

Janka side hardness for dry material 1,630 lb.
Amsler toughness 300-475 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Panga panga seasons well and rather rapidly with little degrade. Wenge rather slowly but also without much distortion. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Panga panga shrinkage green to ovendry: radial 3.1%; tangential 5.8%. Movement in service is rated as small.

Working Properties: Sawing and machining somewhat difficult, rapid blunting of cutting edges occurs, turns well, difficult to glue if resinous.

Durability: Heartwood is rated as very durable and resistant to termite attack.

Preservation: Heartwood extremely resistant to impregnation; sapwood moderately resistant to permeable.

Uses: Parquet or strip flooring, joinery, general construction, specialty items. Wenge is used as a hickory substitute in sporting goods, also for decorative veneers.

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1. Bolza, E., and W. G. Keating.
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MITRAGYNA CILIATA

ABURA

Family: Rubiaceae

Other Common Names: M'Boy (Sierra Leone, Liberia), Bahia (Ivory Coast), Baya, Subaha (Ghana), Elolom (Cameroon), Elelom (Gabon), Vuku, M'Voukou (Zaire), Nzingu (Zambia, Uganda).

Distribution: Mainly West Africa from Sierra Leone to the Congo region and Angola, gregarious in freshwater swamps.

THE TREE Reaches a height of over 100 ft; boles straight and clear to 60 ft; usually free from buttresses; trunk diameter 3-5 ft.

THE WOOD General Characteristics: Heartwood uniform light yellowish- or pinkish-brown; sapwood wide, not usually differentiated. Texture fine and even; grain moderately straight to interlocked or spiral; luster low; sometimes with gum veins that appear as dark streaks; freshly-cut timber has an unpleasant odor. Silica up to 0.24% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45; air-dry density 34 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	7,900	1,180	3,960
12%	12,100	1,350	6,740
12% (<u>4</u>)	10,300	1,020	5,600

Janka side hardness 700 lb for green material and 780 lb for dry. Amsler toughness 116 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly with little or no degrade. Kiln schedule T13-C4S is suggested for 4/4 stock and T11-D3S for 3/4. Shrinkage green to ovendry: radial 4.1%; tangential 9.0%; volumetric 12.0%. Movement in service is rated as small.

Working Properties: Works well with both hand and machine tools and takes a good finish if cutters are kept sharp; blunting is slight to severe because of silica; easy to glue; veneers easily.

Durability: Heartwood is not durable nor resistant to termites; sapwood liable to powder-post beetle attack. Good acid resistance.

Preservation: Heartwood moderately resistant to preservative treatments; sapwood is permeable.

Uses: A general-purpose timber, furniture components, joinery, domestic flooring, plywood, carving.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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1976. Bahia (Abura). Bois For. Trop. 165:21-34.
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MONOPETALANTHUS HEITZII

ADOUNG

Family: Leguminosae

Other Common Names: Adoung de heitz (Gabon).

Distribution: Reported only in northern parts of Gabon; prefers moist soils along rivers and swampy or occasionally inundated areas.

THE TREE Reaches a height of 140 ft; bole straight and cylindrical, clear to 60 ft; trunk diameters 4-6 ft over rather pronounced buttresses.

THE WOOD General Characteristics: Wood pink-brown, darkens slightly on exposure; heartwood and sapwood not clearly demarcated. Texture fine and even; grain often interlocked.

Weight: Basic specific gravity (ovendry weight/green volume) 0.39; air-dry density 33 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	14,300	1,300	7,200

Amsler toughness 220 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Logs should be converted soon after felling to avoid splitting. Seasons easily, but must be done slowly. No information on kiln schedules.
Shrinkage green to ovendry: radial 4.0%; tangential 6.8%; volumetric 10.8%.

Working Properties: Works fairly well but tends to give a woolly finish, a reduced cutting edge angle is suggested to minimize tear due to interlocked grain; glues and nails well; easy to veneer.

Durability: Heartwood moderately durable; sapwood liable to stain and is vulnerable to powder-post beetle attack.

Preservation: Heartwood is resistant to impregnation; sapwood is permeable.

Uses: Furniture components, boxes and crates, light construction, plywood.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

MORUS MESOZYGIA

DIFOU

Family: Moraceae

Other Common Names: Wonton (Ghana), Aye (Nigeria), Kankate (Zaire).

Distribution: Found on the edge of the humid rain forests from Senegal to the Cameroon and Gabon; also in dry savanna formations. Widely planted as a shade and farm boundary tree.

THE TREE Reaches a height of 90-120 ft, bole straight, cylindrical, about 60 ft in length; trunk diameter 2-3 ft, wide-spreading root ridges.

THE WOOD General Characteristics: Heartwood yellow when freshly cut darkening on exposure to a golden- or coffee-brown; sapwood wide, grayish-white, distinct. Texture fine to moderately coarse; grain shallowly interlocked; moderately high luster.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 54 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	24,000	2,260	12,800

Amsler toughness 234 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to have satisfactory seasoning characteristics. No information on kiln schedules. Shrinkage green to ovendry: radial 3.3%; tangential 5.8%; volumetric 8.0%. Reported to be rather stable when manufactured.

Working Properties: Works with moderate ease with most hand and machine tools, good sawing characteristics; glues well; takes a good finish; veneers well.

Durability: Heartwood vulnerable to attack by decay fungi and liable to termite attack.

Preservation: Heartwood extremely resistant to treatment; sapwood is moderately resistant.

Uses: Joinery, turnery, flooring, veneer.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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2. France: Bois For. Trop.
1951. Difou [*Morus mezozygia*]. Bois For. Trop. No. 18/19:143-146.
3. Sallenave, P.
1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Publ. Centre Tech. For. Trop. No. 23.

MUSANGA CECROPIOIDES

AFRICAN CORKWOOD
UMBRELLA TREE

Family: Moraceae

Other Common Names: Parasolier (Ivory Coast), N'Govoge (Sierre Leone), Doe, Govwi (Liberia).

Distribution: Found from Sierre Leone to Angola and eastward to Uganda; typical in secondary forests, common on old farms, short-lived. May form almost pure stands and is suitable for plantation culture.

THE TREE May reach a height of 100 ft; bole slender and rather straight, 20-40 ft in length; trunk diameters mostly 1-3 ft. Prop roots may extend to 9 ft and more above the base. Tree can spread vegetatively by means of aerial runners.

THE WOOD General Characteristics: Wood pale yellow, pale brown, or whitish, heartwood is not distinct from sapwood. Texture coarse; grain straight, luster rather high.

Weight: Basic specific gravity (ovendry weight/green volume) 0.18-0.28; air-dry density 14-21pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	4,600	525	2,620
12% (3)	7,700	1,080	3,620

Amsler toughness 40-120 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: No information on drying characteristics. A kiln schedule similar to T12-D5 has been suggested. Shrinkage green to ovendry: radial 2.2%; tangential 7.0%; volumetric 9.8%. Reported to be moderately unstable when manufactured.

Working Properties: Saws well, but difficult to plane because of low density, difficult to finish.

Durability: Wood has poor durability and is prone to mold and stain.

Preservation: Sapwood is permeable; heartwood resistant to impregnation.

Uses: Modelmaking, insulation, toys, floats (fishnets, rafts), suitable for high-yield pulps.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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NAUCLEA DIDERRICHI
SYN. SARCOCEPHALUS DIDERRICHI

OPEPE

Family: Rubiaceae

Other Common Names: Kusia (Ghana), Badi (Ivory Coast),
Bilinga (Gabon), Akondoc (Cameroon), N'Gulu-maza
(Zaire), Kilingi (Uganda).

Distribution: Widely distributed from Sierra Leone to the Congo region and eastward to Uganda; often found in pure stands.

THE TREE Up to about 160 ft in height, with straight, cylindrical boles clear to 80-100 ft, trunk diameters 3-6 ft.

THE WOOD General Characteristics: Heartwood orange or golden-yellow, darkening on exposure; sapwood whitish or pale yellow, clearly defined. Texture rather coarse; grain usually interlocked or irregular; lustrous; without characteristic odor or taste. An alkaloid in the wood may be toxic to woodworkers.

Weight: Basic specific gravity (ovendry weight/green volume) 0.63; air-dry density 47 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	13,700	1,720	7,490
12%	17,400	1,940	10,400
12% (4)	15,000	2,000	8,600

Janka side hardness 1,520 lb for green and 1,630 lb for dry material. Amsler toughness 220 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Quartersawn stock dries rather rapidly with little checking or warp; flatsawn lumber may develop considerable degrade. Thin stickers and end-coating is suggested. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.5%; tangential 8.4%; volumetric 12.6%. Movement in service is rated as small.

Working Properties: Timber works moderately well with hand and machine tools, requires a slow feed in sawing, a 10 degree cutting angle is suggested for planing to prevent tearing; good gluing; takes a satisfactory finish. Poor steam-bending characteristics.

Durability: Heartwood is rated as very durable but is moderately resistant to termites. Sapwood liable to powder-post beetle attack. Heartwood resistant to marine borers.

Preservation: Sapwood permeable; heartwood moderately resistant.

Uses: Dock and marine work, boatbuilding (except bent work), railway crossties, general construction, flooring, furniture and cabinet parts.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois For. Trop.
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NESOGORDONIA PAPAVERIFERA
SYN. CISTANTHERA PAPAVERIFERA

DANTA

Family: Sterculiaceae

Other Common Names: Kotibé (Ivory Coast), Otutu (Nigeria), Owoé (Cameroon), Arborbora (Gabon), Kondofindo (Zaire), Naouya (Angola), Abumana, Akumaba, Epro (Ghana).

Distribution: Found from Sierra Leone to Cameroon and northern Gabon, occupies mixed and dry deciduous forests and transitional forests.

THE TREE May reach a height of 90-120 ft; bole usually straight, cylindrical, and clear 40-80 ft; trunk diameters 2-1/2-3-1/2 ft over short buttresses.

THE WOOD General Characteristics: Heartwood reddish-brown; sharply defined from 2-3 in. wide lighter-colored sapwood. Texture is fine and even; grain narrowly interlocked producing a stripe figure; medium luster; without characteristic odor or taste. Wood marked with dark streaks of scar tissue, pin knots. Slight greasy feel.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65; air-dry density 50 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	19,800	1,690	10,050
12% (3)	18,600	1,580	9,450

Janka side hardness 2,140 lb and Amsler toughness 366 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons rather slowly and with little degrade, collapse may occur in kiln-drying. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 5.4%; tangential 8.2%; volumetric 12.4%. Movement in service is rated as medium.

Working Properties: Works well with hand and machine tools, moderate blunting of cutters, a cutting angle of 15 degrees is suggested to avoid tearing of grain in planing, good slicing timber, glues well, moderate steam-bending properties.

Durability: Heartwood is rated as durable and fairly resistant to termite attack. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is very resistant to preservative treatments; sapwood moderately so.

Uses: General construction, floors, joinery, turnery, boat-building, tool handles, gunstocks, plywood, utility crossarms, furniture. Considered a hickory substitute.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois For. Trop.
1974. Kotibé [Nesogordonia papaverifera]. Bois For. Trop. 157:41-51.

OCOTEA USAMBARENSIS

EAST AFRICAN CAMPHORWOOD

Family: Lauraceae

Other Common Names: Muwong, Maasi, Mkulo (Tanzania), Mwiha (Uganda).

Distribution: Occurs in wet montane forests at altitudes of 3,000-9,000 ft; mainly in Kenya and Tanzania, sparse in Uganda.

THE TREE Reaches a height of 120-150 ft; bole straight and clear to about 50 ft; trunk diameters to 7 ft, occasionally to 10 ft. Mature trees often have heartrot.

THE WOOD General Characteristics: Heartwood light yellowish-brown, darkening to a deep brown on exposure; sapwood slightly paler, not clearly demarcated. Texture medium to fine and even; grain interlocked producing a stripe figure; sometimes lustrous; timber has a distinct camphor scent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.51; air-dry density 37 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	8,500	1,180	4,440
12%	13,300	1,440	7,590
12% (<u>2</u>)	10,900	1,440	6,790

Janka side hardness 760 lb for green material and 930 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons fairly well; but rather slowly, particularly thick stock. Kiln schedule T8-B3 is suggested for 4/4 stock and T5-B1 for 8/4. Shrinkage green to 12% moisture content: radial 2.5%; tangential 4.0%. Movement in service rated as small.

Working Properties: Works easily with hand and machine tools, in planing interlocked grain a cutting angle of 20 degrees is suggested, good gluing and moderate steam-bending properties, finishes satisfactorily.

Durability: Heartwood is rated as very durable but is vulnerable to termite attack and marine borers. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is rated as extremely resistant to preservative treatments; sapwood is permeable.

Uses: Cabinet and furniture work, joinery, flooring, sliced veneer, boatbuilding.

ADDITIONAL READING

1. Bolza, and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

ODYENDEA SPP.

ONZANG
MBANKO

Family: Simaroubaceae

Other Common Names: Odieneze (Gabon).

Distribution: Mbanko (*O. zimmermannii*) reported in Tanzania and Kenya; Onzang (*O. gabonensis*) found in Gabon.

THE TREE Reaches a height of 120-130 ft; bole up to 80 ft with good form, Onzang is fluted; trunk diameters 5-6 ft.

THE WOOD General Characteristics: Wood whitish to straw-colored, sapwood and heartwood not differentiated. Texture coarse; grain irregular.

Weight: Basic specific gravity (ovendry weight/green volume) 0.32; air-dry density 24 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	6,350	825	4,050

Amsler toughness 44 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly with little checking but warp is severe. No information on kiln schedules. Shrinkage green to ovendry: radial 3.2%; tangential 5.4%; volumetric 8.8%.

Working Properties: Springs and splits severely during log conversion; dried stock saws, planes, and nails easily, easy to peel into veneers.

Durability: Wood is vulnerable to attack by decay fungi, stain, and termites. Logs should be converted soon after felling or chemically treated to minimize degrade.

Preservation: Sapwood permeable; heartwood of Mbanko moderately resistant.

Uses: Boxes and crates, veneer, plywood, pulpwood, particleboard.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Sallenave, P.
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OLEA HOCHSTETTERI

EAST AFRICAN OLIVE

Family: Oleaceae

Other Common Names: Olmasi, Ngwe (Tanzania), Musharagi (Kenya).

Distribution: Montane rain forests at elevations of 6,000-9,000 ft; common in Kenya and parts of Zaire but less frequent in Uganda and Tanzania.

THE TREE May reach a height of 80-100 ft, but is often smaller; bole rarely straight, heavily fluted, about 15-30 ft in length; trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood pale brown with irregular dark gray-brown streaks; sapwood up to 2 in. wide, pale yellow, clearly demarcated. Texture fine and even; grain straight or shallowly interlocked, figured; surface slightly oily.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72; air-dry density 55 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	15,300	1,980	7,080
12%	25,300	2,530	12,200

Janka side hardness 1,840 lb for green and 2,740 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Timber dries very slowly with a strong tendency to check and warp; honeycomb may develop in thick material if dried too rapidly. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial 4.0%; tangential 6.5%. Movement in service is rated as large.

Working Properties: Easy to saw when green, difficult to work by hand, a smooth clean finish is obtained in planing, excellent turning properties, moderate steam-bending properties.

Durability: Heartwood has low to moderate durability, susceptible to termite attack.

Preservation: Heartwood moderately resistant to preservative treatments; sapwood permeable.

Uses: Furniture, decorative veneer, turnery, decorative flooring, tool handles.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

ONGOKEA GORE

ANGUEUK

Family: Olacaceae

Other Common Names: Kouéro (Ivory Coast), Andjek, Angueuk (Gabon, Cameroon), Boleko (Zaire).

Distribution: From Liberia to the Congo region; found in evergreen humid forests and periodically inundated areas.

THE TREE May reach a height of 130 ft; bole is straight and cylindrical, unbuttressed but sometimes lobed or swollen at the base; trunk diameters to 5 ft.

THE WOOD General Characteristics: Heartwood pale yellow not always differentiated from the 3-4-in. wide sapwood. Texture fine and even; grain straight, somewhat interlocked, or wavy; luster rather low. Ribbonlike markings on quartersawn surfaces.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72; air-dry density 55 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	20,800	2,340	10,800
12% (3)	13,700	1,450	8,600

Amsler toughness 110-150 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Should be quartersawn to avoid warp.
No information on kiln schedules. Shrinkage green to ovendry: radial 4.0%; tangential 10.7%; volumetric 14.1%.

Working Properties: Saws well but slowly, planes and machines well to a smooth finish, easy to glue, easy to slice into veneer.

Durability: Heartwood is rated as durable and is rarely attacked by termites; sapwood is liable to stain and powder-post beetle attack.

Preservation: Heartwood is resistant to impregnation; sapwood is moderately resistant.

Uses: General carpentry work, joinery, flooring, veneer, turnery. Fruits are edible, kernels used for soap and lubricants.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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OXYSTIGMA OXYPHYLLUM

TCHITOLA

Family: Leguminosae

Other Common Names: Lolagbola (Nigeria), M'Babou (Gabon), Tshibudimbu (Zaire), Tola mafuta (Angola).

Distribution: Occurs in tropical West Africa from Nigeria to Gabon and the Congo region; usually in dense mixed formations along rivers and lakeshores.

THE TREE Up to 150 ft in height; bole straight and cylindrical, clear to 70 ft, unbuttressed; trunk diameter 2-3 ft, sometimes to 6 ft.

THE WOOD General Characteristics: Heartwood reddish-brown with dark gum rings, suggesting walnut; sapwood 4-5 in. wide, light yellow-pink, distinct. Texture variable from fine to moderately coarse; grain straight or shallowly interlocked; a gummy wood.

Weight: Basic specific gravity (ovendry weight/green volume) 0.53; air-dry density 40pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,700	1,520	5,700
12%	16,200	1,680	8,300
12% (4)	15,000	1,350	8,100

Janka side hardness 1,100 lb for green and 1,250 lb for dry material. Amsler toughness 188 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little checking or warp. A kiln schedule similar to T5-D2 has been suggested. Shrinkage green to oven-dry: radial 5.1%; tangential 10.7%. Reported to have a small movement in service.

Working Properties: Saws easily and works well with hand and machine tools, presence of gum may clog the cutters, nails and glues well, peels and slices well, takes a satisfactory finish.

Durability: Heartwood durability variable, generally moderately resistant, not very susceptible to termite attack. Logs, however, must be removed from the forest soon after felling to avoid degrade due to insect and fungal attack. Sapwood liable to powder-post beetle attack.

Preservation: Reported as probably permeable to preservative treatments.

Uses: Decorative veneers, furniture and cabinetwork, joinery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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3. Lavers, G. M.
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PARINARI EXCELSA

SOUGUÉ

Family: Chrysobalanaceae

Other Common Names: Mubura (Tanzania, Uganda), Kpar (Liberia), Esagko, Inyi (Nigeria), Mampata (Senegal).

Distribution: Widely distributed in tropical Africa, occurs gregariously at elevations between 3,000 and 6,000 ft.

THE TREE Grows to a height of 150-170 ft; bole cylindrical, mostly straight, usually clear to 60-90 ft; buttressed to a height of 10 ft, trunk diameters 3-5 ft.

THE WOOD General Characteristics: Heartwood pale red- or chocolate-brown, darkening on exposure; sapwood yellowish-white, sharply demarcated. Grain usually interlocked and irregular; texture moderately coarse; has a honey scent when freshly sawn, disappears on drying. Silica content often 1% or more.

Weight: Basic specific gravity (ovendry weight/green volume) 0.62-0.75; air-dry density 47-57 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	17,800	1,940	9,500
12% (4)	23,600	2,260	12,000

Janka side hardness 1,720 lb for dry material.
Amsler toughness 228 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons slowly with a tendency to check and warp. Air-drying prior to kiln drying is suggested. Kiln schedule T2-C2 is suggested for 4/4 stock. Shrinkage green to oven dry: radial 6.6%; tangential 10.2%; volumetric 16.0%. Movement in service is rated as large.

Working Properties: Dry timber is difficult to work with hand and machine tools due to high silica, tungsten-carbide tipped cutters are needed, has moderately good steam-bending properties, glues satisfactorily.

Durability: Heartwood is nondurable and liable to termite attack; reported to be resistant to marine borers.

Preservation: Heartwood fairly resistant to treatment; sapwood permeable.

Uses: Mining timbers, heavy construction, railroad crossties (if treated). Has an edible fruit.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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PERICOPSIS ELATA
SYN. AFRORMOSIA ELATA

AFRORMOSIA

Family: Leguminosae

Other Common Names: Kokrodua (Ghana), Assamela (Ivory Coast).

Distribution: West Africa, but mainly Ghana and the Ivory Coast, gregarious, grows in both wet and dry areas.

THE TREE May reach a height of 150 ft; bole somewhat irregular, clear to 90-100 ft, buttressed to 8 ft and then fluted; trunk diameters 3-6 ft.

THE WOOD General Characteristics: Heartwood yellow-brown turning to a dark brown on exposure; sapwood narrow, lighter in color and clearly demarcated. Texture moderately fine; grain straight to interlocked; some resemblance to teak.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 43pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	15,600	1,650	7,800
12%	19,400	1,810	10,350

12% (3)	11,600	1,370	9,100
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Janka side hardness about 1,560 lb for dry material. Amsler toughness 166 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rather slowly with little degrade apart from slight warp. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 3.0%; tangential 6.4%; volumetric 10.7%. Movement in service is rated as small.

Working Properties: Works well with hand and machine tools, finishes cleanly, turns satisfactorily, good gluing, moderate steam-bending properties. Sawdust reported to be an eye irritant, good ventilation needed.

Durability: Heartwood is rated as very durable and highly resistant to termite attack. Dark stains liable to appear if in contact with iron under damp conditions.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood fairly permeable.

Uses: Boatbuilding, joinery, flooring, furniture, decorative veneers, considered an excellent teak substitute.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
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PIPTADENIASTRUM AFRICANUM
SYN. PIPTADENIA AFRICANA

DAHOMA

Family: Leguminosae

Other Common Names: Mbeli (Liberia), Dabéma (Ivory Coast),
Dahoma (Ghana), Agboin, Ekhimi (Nigeria), Atui
(Cameroon), Bokungu (Zaire), Mpewere (Uganda).

Distribution: Tropical West Africa from Senegal to Angola and across the Congo region to Uganda. Found in mixed deciduous and evergreen forests, often stands as a single tree on farmland.

THE TREE Reaches a height of 150 ft; boles straight, cylindrical, clear to 50 ft, buttresses sharp and widespread to 15 ft. Coppices well.

THE WOOD General Characteristics: Heartwood light to golden-brown; sapwood 2 in. wide, grayish to pale straw, distinct. Texture coarse; grain broadly interlocked producing an attractive ribbon figure; moderate luster; unpleasant odor when freshly cut and may return if timber is rewetted; sawdust may irritate skin and mucous membranes; may stain if in contact with iron under moist conditions.

Weight: Basic specific gravity (ovendry weight/green volume) 0.56; air-dry density 43pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,000	1,430	5,320
12%	15,800	1,620	8,520
12% (3)	16,000	1,790	8,250

Janka side hardness 1,320 lb for green and 1,540 lb for dry material. Amsler toughness 266 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly, air-drying prior to kiln-drying is suggested; some material prone to collapse and warp, collapse not removable by reconditioning. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to ovendry: radial 3.9%; tangential 8.7%; volumetric 12.5%. Movement in service is rated as medium.

Working Properties: Works well, blunting of knife edges most pronounced in sawing, a cutting angle of 15 degrees is suggested for planing knives to minimize tearing of interlocked grain, nailing and gluing satisfactory, moderate wood-bending characteristics.

Durability: Heartwood is rated as durable, reported to be resistant to termite attack in West Africa but only moderately so in South Africa.

Preservation: Heartwood is rated as resistant to preservative treatments; sapwood moderately resistant.

Uses: Heavy construction, wharf decking, flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
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PODOCARPUS spp.

PODO

Family: Podocarpaceae

Other Common Names: Yellowwood (South Africa), Wiriwiri, Ilse, Mushunga (Tanzania), Musenene, Sapta (Uganda).

Distribution: Species supplying commercial timber are widely distributed in the highlands of East Africa, mainly in Kenya south to Rhodesia.

THE TREE May attain a height of 100 ft or more with diameters mostly 1-1/2 to 2-1/2 ft.

THE WOOD General Characteristics: Uniform light yellowish-brown with no clear distinction between sapwood and heartwood, sometimes showing red streaks due to presence of compression wood. Texture very fine and even; grain straight; growth rings usually indistinct; resin ducts absent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.43; air-dry density 32pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	6,950	380	3,200
12%	11,900	1,170	6,250
12% (<u>1</u>)	10,230	1,385	6,470

Janka side hardness 560 lb for green material and 830 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with some checking and a pronounced tendency to warp. Distortion can be minimized if the timber pile is weighted. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to ovendry: radial 2.8%; tangential 5.1%. Movement in service is rated as small.

Working Properties: Easy to work with hand and machine tools, takes an excellent finish, shapes and turns well, glues easily, easy to veneer, moderate steam-bending properties.

Durability: Heartwood has low durability and liable to termite damage as well as other insect attack.

Preservation: Easy to treat, open-tank treatments result in preservative oil absorptions of 14-25 pcf. Retentions of around 40 pcf can be obtained with a pressure treatment.

Uses: General construction, joinery, millwork, furniture components, boxes and crates, food containers, utility plywood.

ADDITIONAL READING

1. Banks, C. H.
1954. The mechanical properties of timbers with particular reference to those grown in the Union of South Africa. Jour. S. Africa For. Assoc. 24:44-65.
2. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
3. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
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POGA OLEOSA

OVOGA

Family: Rhizophoraceae

Other Common Names: Inoi (Nigeria), Ngalé (Cameroon), Ovoga, Afo (Gabon).

Distribution: Distributed from Nigeria to the Congo region in the dense equatorial forests, often along riverbanks and coastland.

THE TREE May reach a height of 150 ft; bole straight and cylindrical, 50-60 ft in length; trunk diameter to 4 ft.

THE WOOD General Characteristics: Heartwood pink-red or pink-buff; sapwood whitish with pink stripes, well differentiated. Texture coarse; grain interlocked or variable, has a "silver grain" figure when quartersawn due to broad rays.

Weight: Basic specific gravity (ovendry weight/green volume) 0.36; air-dry density 27 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	9,050	940	5,250
12% (3)	9,800	1,040	5,550

Amsler toughness 67-160 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries with little difficulty, not prone to warp if quartersawn. No information on kiln schedules. Shrinkage green to ovendry: radial 2.8%; tangential 8.0%; volumetric 13.1%.

Working Properties: Works easily with hand and machine tools, takes a smooth finish, peels and slices well, satisfactory gluing, takes nails and screws easily.

Durability: Wood is not durable, prone to termite attack, poor weathering characteristics.

Preservation: No information.

Uses: Decorative veneers, furniture components, boxes and crates, general woodworking, joinery. Tree produces edible nuts with a high oil content.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.
3. Sallenave, P.
1964. Propriétés physiques et mécaniques des bois tropicaux. Premier Supplément. Publ. Centre Tech. For. Trop. No. 23.

PTEROCARPUS ANGOLENSIS

MUNINGA

Family: Leguminosae

Other Common Names: Mutete (Angola), Mukwa (Rhodesia), Mtumbati (Tanzania), Kiatt, Kajat (South Africa).

Distribution: A wide distribution over south-central Africa, common in savanna woodland.

THE TREE Commonly grows to a height of 40-60 ft; bole usually straight, 10-25 ft; trunk diameter 1-1/2 to 2-1/2 ft.

THE WOOD General Characteristics: Heartwood highly variable, pale uniform brown, golden-brown, chocolate-brown, brick-red, or purplish-brown, with darker or redder streaks that tone down on exposure; sapwood pale gray or yellowish, clearly defined. Texture medium to coarse; grain straight to interlocked; attractive figure; no luster; scent faint and aromatic. Dry sawdust may cause nasal irritation and bronchial asthma.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.59; air-dry density 41pcf. Timber from Rhodesia is rather lighter in weight (34 pcf).

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	12,300	1,100	5,890
12%	13,700	1,220	8,280

Janka side hardness 1,300 lb for green material and 1,480 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries very well but slowly, no warping and little or no tendency to check or split. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to 12% moisture content: radial 1.0%; tangential 1.5%. Movement in service is rated as small.

Working Properties: Works well with hand and machine tools, only moderate blunting of cutters, straight-grained material planes and shapes to a good finish, peels and slices cleanly, good gluing, excellent turning and carving.

Durability: Heartwood is rated as durable or moderately so, and very resistant to moderately so to termites and marine borers; sapwood is liable to powder-post beetle attack.

Preservation: Heartwood is resistant to preservative treatments; sapwood moderately resistant.

Uses: Furniture, fine joinery, flooring, decorative veneer, turnery, boatbuilding.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

PTEROCARPUS SOYAUXII

AFRICAN PADAUK

Family: Leguminosae

Other Common Names: Mbé, Mbil (Cameroon), Ngula, Bosulu (Zaire).

Distribution: Central and tropical West Africa; common in dense equatorial rain forests, often in small groups.

THE TREE Reaches a height of 100-130 ft, bole straight, cylindrical, and clear to 70 ft; trunk diameters 2-4 ft, sometimes to 5 ft.

THE WOOD General Characteristics: Heartwood vivid red when freshly cut darkening to a purple-brown on exposure; sapwood 4-8 in. wide, whitish to brown-yellow, distinct. Texture coarse; grain straight to interlocked; lustrous; faint aromatic scent when freshly cut. Sawdust may cause respiratory problems.

Weight: Basic specific gravity (ovendry weight/green volume) 0.55-0.67; air-dry density 42-51 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	13,900	1,560	8,450
12% (3)	18,600	1,750	7,800

Amsler toughness 155-272 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries very well with a minimum of degrade. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 3.3%; tangential 5.2%; volumetric 7.6%. Movement in service is very small.

Working Properties: Saws well but requires slow feed, easy to machine but with some tearing of interlocked grain, takes a good finish, glues easily and holds nails and screws satisfactorily.

Durability: Heartwood is very durable and very resistant to termite attack.

Preservation: Heartwood fairly resistant to preservative treatments; sapwood moderately resistant. Excellent weathering properties.

Uses: Fine joinery, fancy turnery, carvings, flooring, decorative veneer, tool and knife handles.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
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PTERYGOTA spp.

PTERYGOTA

Family: Sterculiaceae

Other Common Names: Kyere, Awari, Okyere (Ghana), Koto (Ivory Coast), Poroposo, Kefe (Nigeria).

Distribution: Common in tropical evergreen and mixed deciduous forests of West Africa.

THE TREE May reach a height of 120 ft; bole rather straight and cylindrical, clear to 40-80 ft, buttressed to 20 ft; trunk diameters 2-4 ft.

THE WOOD General Characteristics: Wood pale yellow to a creamy-white with little differentiation between sapwood and heartwood. Texture rather coarse; grain straight to interlocked; green material has an unpleasant smell which disappears on drying; high rays give a conspicuous flecked figure; commonly with small knot clusters.

Weight: Basic specific gravity (ovendry weight/green volume) 0.47-0.56; air-dry density 35-43 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	10,600	1,270	5,130
12%	16,100	1,670	8,400
Green (<u>2</u>)	8,300	1,080	3,870
12%	12,300	1,340	6,300
12% (<u>3</u>)	17,800	2,140	8,450

Janka side hardness 670-790 lb for green material and 940-970 lb for dry. Amsler toughness 260 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Timber seasons fairly rapidly with only a slight tendency to check or warp. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 5.7%; tangential 11.4%; volumetric 15.0%. Movement in service rated as medium.

Working Properties: Works fairly easily with hand and machine tools, a cutting angle of 20 degrees is suggested to reduce tearing of interlocked grain in planing, glues and nails satisfactorily, peels and slices into veneers satisfactorily.

Durability: Heartwood is not durable and is liable to termite attack; sapwood liable to powder-post beetle attack. Logs are prone to stain and insect attack requiring rapid removal from the forest or a chemical treatment.

Preservation: Heartwood moderately resistant to impregnation; sapwood permeable.

Uses: Furniture components, joinery, general carpentry, boxes and crates, plywood.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.),
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

PYCNANTHUS ANGOLENSIS

ILOMBA

Family: Myristicaceae

Other Common Names: Gboyei (Sierra Leone, Liberia), Oualélé, Waleié (Ivory Coast), Otie (Ghana), Akomu (Nigeria), Eteng (Cameroon), Lolako (Zaire), Pycnanthus (Great Britain).

Distribution: Rain forests, transitional, and secondary formations of West Africa.

THE TREE Reaches a height of 130 ft; bole straight, cylindrical, and clear to 60 ft, sometimes with a swollen base or root swellings; trunk diameter 2-3 ft or occasionally more.

THE WOOD General Characteristics: Wood whitish, pinkish-brown, sometimes with yellowish markings, sapwood not clearly differentiated from heartwood. Texture medium to coarse; grain generally straight, no luster; freshly sawn material may have an unpleasant odor which disappears on drying.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40; air-dry density 31 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	10,400	1,210	5,700

Amsler toughness 163 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons rapidly but is prone to collapse, warp and splitting. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4, requires reconditioning to remove collapse. Shrinkage green to ovendry: radial 4.6%; tangential 8.4%; volumetric 12.8%.

Working Properties: Saws easily and works well with hand and machine tools, excellent peeler, good gluing and nailing characteristics.

Durability: Wood is perishable and liable to termite attack, vulnerable to powder-post beetle attack. Logs require rapid extraction and conversion to avoid insect and fungal degrade.

Preservation: Heartwood and sapwood are permeable.

Uses: A general-utility timber, furniture components, interior joinery, plywood.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
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3. France: Bois For. Trop.
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PYGEUM AFRICANUM
SYN. PRUNUS AFRICANUM

MUERI

Family: Rosaceae

Other Common Names: Mkomohoyo, Mseneo (Tanzania), Ntasesa (Uganda), Tenduet, Mueri (Kenya).

Distribution: Found mainly in Kenya, Uganda, Tanzania, and Zaire; semitropical rain forests at altitudes of 5,000-9,000 ft.

THE TREE May reach a height of 120 ft, but may vary markedly according to site; bole straight and clear to 50 ft, sometimes buttressed; trunk diameter to 3 ft.

THE WOOD General Characteristics: Heartwood pale red when freshly cut, turning on exposure to a dark rich red color; sapwood pale pink, not clearly defined. Texture medium to fine; grain straight to interlocked.

Weight: Basic specific gravity (ovendry weight/green volume) 0.58; air-dry density 45 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (4)*	17,700	1,640	9,100

Janka side hardness 1,860 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Very difficult to season, dries slowly, liable to checking, warp, and collapse. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Volumetric shrinkage green to ovendry 9.1%.

Working Properties: Seasoned wood saws easily and cleanly, works well with hand and machine tools, difficult to nail, polishes and finishes well.

Durability: Heartwood is perishable. Sapwood liable to powder-post beetle attack.

Preservation: Resistant to preservative treatments.

Uses: Flooring, heavy construction where durability is not required, furniture components.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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4. Lavers, G. M.
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RICINODENDRON HEUDELOTII

ERIMADO

Family: Euphorbiaceae

Other Common Names: Munguella (Angola), Essessang (Cameroon), Bofeko (Zaire), Wama (Ghana), Okhuen (Nigeria), Kishongo (Uganda).

Distribution: West tropical Africa from Guinea to Angola and eastward to Uganda; occurs in rain forests but is typical of secondary formations and is common on abandoned farmland.

THE TREE May reach a height of 100 ft sometimes only 20-30 ft, bole straight and cylindrical; trunk diameter 3-4 ft; sometimes buttressed.

THE WOOD General Characteristics: Wood whitish or pale yellow, darkening on exposure, sapwood and heartwood not differentiated. Texture rather coarse; grain straight; without luster.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.20; air-dry density 15 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	4,550	525	2,480
12% (3)	5,240	625	2,800
12% (3)	5,000	680	2,980

Amsler toughness 22-50 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons rapidly with little or no degrade. No information on kiln schedules. Shrinkage green to ovendry: radial 2.0%; tangential 4.8%; volumetric 7.6%.

Working Properties: Saws and works easily, nails without splitting.

Durability: Liable to decay and termite attack. Logs are prone to staining and requires rapid extraction and conversion.

Preservation: Permeable to preservatives.

Uses: Boxes and crates, plywood core stock, carvings, fishnet floats. Considered a good balsa substitute.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Chalk, L., et al.
1933. Twenty West African timber trees. Clarendon Press. Oxford.
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SCOTTELLIA CORIACEA

ODOKO

Family: Flacourtiaceae

Other Common Names: Koroko, Dein (Ghana), Mehr-chu (Liberia), Aburuhi (Ivory Coast), Emwenfuohai (Nigeria).

Distribution: West Africa from Liberia to southern Nigeria; found in evergreen rain forests, often in small stands and along banks of streams.

THE TREE Reaches a height of 100 ft; bole straight, slightly fluted at the base; trunk diameters 1-2 ft.

THE WOOD General Characteristics: Wood is pale yellow without distinction between heartwood and sapwood. Texture is fine; grain generally straight, occasionally slightly interlocked; conspicuous rays show a "silver-grain" figure when quartersawn.

Weight: Basic specific gravity (ovendry weight/green volume) 0.56; air-dry density 41 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	12,100	1,640	5,600
12%	16,900	1,860	9,220

Janka side hardness 990 lb for green material and 1,090 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries fairly rapidly with a pronounced tendency to surface and end check but little warp. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to 12% moisture content: radial 2.5%; tangential 5.0%. Movement in service is rated as medium.

Working Properties: Saws easily and works well with hand and machine tools, good gluing, screwing, and peeling characteristics, tends to split on nailing.

Durability: The wood is not durable and is liable to termite attack. Requires rapid harvest and conversion or chemical treatments to avoid stain.

Preservation: Sapwood and heartwood permeable.

Uses: Furniture, joinery, flooring, turnery. A general-utility wood.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

SCYPHOCEPHALIUM OCHOCOA

SORRO

Family: Myristicaceae

Other Common Names: Sogho, Ossoko (Gabon).

Distribution: Gabon and Cameroon; occurs in lowland rain forests often on swampy ground, also on abandoned farmland.

THE TREE May reach a height of 120 ft; bole straight, fluted, to 70 ft in length; trunk diameters to 3 ft.

THE WOOD General Characteristics: Heartwood dark red-brown or orange-brown with some gray streaks; sapwood very wide, gray-buff, distinct. Texture medium to coarse; grain straight; wood contains a red latex.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.48; air-dry density 36 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	11,600	2,040	6,000
12% (2)	10,000	965	4,150
12% (3)	11,200	1,350	7,000

Amsler toughness 83-110 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Air-dries rapidly and well. No information on kiln schedules. Shrinkage green to ovendry: radial 3.6%; tangential 4.8%; volumetric 6.8%.

Working Properties: Saws well and works easily with hand and machine tools, planes to a smooth finish.

Durability: Heartwood durability is low and is liable to insect attack.

Preservation: Heartwood moderately resistant; sapwood permeable.

Uses: General interior carpentry work, joinery, flooring, furniture components, turnery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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4. Yvon, J.
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STAUDTIA STIPITATA
SYN. S. GABONENSIS

NIOVÉ

Family: Myristicaceae

Other Common Names: M'bonda (Cameroon), Niové, M'boun (Gabon), Kamashi, Nkafi (Zaire).

Distribution: Found in Gabon, Cameroon, and the Congo region; occurs in mixed forests, in large stands, as well as secondary forests.

THE TREE Reaches a height of 70-100 ft; bole is cylindrical, straight and clear to 60 ft; butt is sometimes swollen; trunk diameter to 3 ft.

THE WOOD General Characteristics: Heartwood red-brown to yellow-brown with darker streaks; sapwood 4 in. wide, pale yellow to orange-brown. Texture is very fine; grain straight; slightly lustrous and occasionally oily; pepperlike scent.

Weight: Basic specific gravity (ovendry weight/green volume) 0.75; air-dry density 57 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	23,500	--	11,300
12% (4)	25,400	2,300	13,300

Amsler toughness 155-272 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons slowly and requires care to avoid end checking, little warp. No information on kiln schedules. Shrinkage green to ovendry: radial 5.5%; tangential 7.2%; volumetric 12.5%. Movement in service is small.

Working Properties: Timber saws slowly but with little difficulty, tungsten-carbide tipped cutters are suggested; planes with ease to produce a smooth finish, glues satisfactorily. Should be quartersawn. If steamed, suitable for slicing.

Durability: Excellent durability and resistant to termite attack. Excellent weathering properties.

Preservation: Difficult to treat.

Uses: Cabinetwork, joinery, decorative veneers, flooring, turnery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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STERCULIA OBLONGA

YELLOW STERCULIA

Family: Sterculiaceae

Other Common Names: Okoko (Nigeria), Bi (Ivory Coast), Eyong, Bongele (Cameroon), N'chong (Gabon).

Distribution: Tropical West African forests from Liberia to Gabon, found in the transition zone between the humid evergreen and semideciduous forests as well as secondary forests.

THE TREE Reaches a height of 80-120 ft; bole straight, cylindrical, and clear to 50-70 ft, sharp buttresses to a height of 12 ft, trunk diameters 1-1/2 to 3 ft.

THE WOOD General Characteristics: Heartwood creamy-white to light yellowish-brown; sapwood 4-8 in. wide, pale in color and not clearly demarcated. Texture rather coarse; grain shallowly interlocked; freshly cut wood has a disagreeable odor which does not persist; high rays produce an attractive lustrous figure on quartersawn stock.

Weight: Basic specific gravity (ovendry weight/green volume) 0.61; air-dry density 48 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,700	1,500	5,610
12%	17,900	1,980	9,750
12% (4)	17,700	1,930	9,400

Janka side hardness 880 lb for green and 1,120 lb for dry material. Amsler toughness 282 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly with a marked tendency to surface and end checking, cup, and collapse. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.5%; tangential 10.8%; volumetric 14.2%. Movement in service is rated as medium.

Working Properties: Works rather well with machine tools but difficult to work with hand tools, blunting of cutting edges is moderate, a cutting angle of 20 degrees is suggested to reduce grain tear in planing; nailing and gluing satisfactory; moderate steam-bending properties.

Durability: Heartwood is nondurable and not resistant to termite attack; sapwood liable to powder-post beetle attack and stain.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood permeable.

Uses: Construction work where durability is not required, decorative veneer, flooring, furniture components.

ADDITIONAL READING

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4. Sallenave, P.
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STERCULIA RHINOPETALA

BROWN STERCULIA

Family: Sterculiaceae

Other Common Names: Wawabima (Ghana), Lotofa (Kvory Coast), Aye (Nigeria).

Distribution: Lowland rain forests and savanna forests of Nigeria, Ghana, and Ivory Coast.

THE TREE Reaches a height of 90-120 ft; bole straight and cylindrical, clear to 70 ft; trunk diameters 2-4 ft; narrow buttresses extend to a height of 10 ft.

THE WOOD General Characteristics: Heartwood pale to deep reddish-brown; sharply demarcated from the 2-in.-wide straw-colored sapwood. Texture rather coarse; grain straight to somewhat interlocked; slight bitter taste but no odor; numerous high rays produce an attractive figure when quartersawn.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.64; air-dry density 50pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	12,600	1,560	6,170
12%	21,000	2,040	10,100
12% (3)	21,300	--	10,300

Janka side hardness 1,410 lb for green and 1,810 lb for dry material. Amsler toughness 292 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Timber dries slowly, liable to severe degrade due to cupping, end checking, and collapse. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to 12% moisture content: radial 5.0%; tangential 9.5%. Movement in service is large.

Working Properties: Saws rather woolly with a tendency to spring, however works satisfactorily with hand and machine tools, tends to split on nailing, glues well, stains and polishes well but requires filler, has moderate steam-bending properties.

Durability: Heartwood has only moderate durability and moderately resistant to termite attack; sapwood liable to stain and powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood moderately resistant.

Uses: Heavy construction work where high durability is not required, tool handles, furniture components, flooring.

ADDITIONAL READING

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2. Farmer, R. H. (ed.).
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STROMBOSIA GLAUCESCENS

AFINA

Family: Olacaceae

Other Common Names: Poé (Ivory Coast), Itako, Otingbo (Nigeria).

Distribution: From Sierra Leone to the Congo region; found in rain forests, often as a dominant, and in transitional formations.

THE TREE Up to 100 ft in height; bole straight and slender, without buttresses; trunk diameter up to 1-1/2 ft.

THE WOOD General Characteristics: Heartwood pink or pale brown with purplish streaks; sapwood wide, yellowish and sharply defined. Texture fine; grain fairly straight; lustrous; has an unpleasant smell when freshly cut; rather oily to touch.

Weight: Basic specific gravity (ovendry weight/green volume) 0.80; air-dry density 61 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	28,200	2,370	13,100

Amsler toughness 505 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Difficult to season, liable to surface and end checking. No information on kiln schedules.
Shrinkage green to oven dry: radial 7.2%; tangential 10.2%; volumetric 15.0%.

Working Properties: Timber saws cleanly but is apt to spring and split, works well and takes a smooth finish, glues well, splits in nailing and requires preboring, can be sliced into veneers.

Durability: Heartwood is highly durable and is immune to termite and other insect attack.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood fairly permeable.

Uses: Often used in the round as building poles and transmission poles (treated), striking tool handles, turnery, heavy-duty flooring. Oil from seeds is used for ointment and soap. Suggested as a substitute for European boxwood.

ADDITIONAL READING

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SWARTZIA FISTULOIDES

DINA

Family: Leguminosae

Other Common Names: Oken, Ndina, Awong (Gabon), Kiela Kusu (Congo-Brazzaville).

Distribution: From Ivory Coast to Gabon and the Congo region; found in the dense rain forests, in small groups.

THE TREE May reach a height of 70-90 ft; bole irregular, short; base of tree sometimes swollen; trunk diameter 2-3 ft.

THE WOOD General Characteristics: Heartwood pink, yellow, or dark brown, striped with red-brown bands on quartered surfaces; sapwood whitish or pale brown, distinct. Texture rather coarse; grain wavy or interlocked.

Weight: Basic specific gravity (ovendry weight/green volume) 0.82; air-dry density 64pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	<u>Psi</u>	<u>1,000 psi</u>	<u>Psi</u>
12% (2)*	25,800	2,580	13,100
12% (2)	22,400	2,380	13,800

Amsler toughness 322-376 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons slowly with some surface and end checking. No information on kiln schedules. Shrinkage green to ovendry: radial 4.2%; tangential 5.8%; volumetric 10.7%.

Working Properties: Works well with machine tools, planes satisfactorily with little grain tearing, often chars in boring, glues well, can be cut into veneers if steamed or heated.

Durability: Heartwood is very durable and is immune to termites and other insects.

Preservation: Heartwood and sapwood extremely resistant to preservative treatments.

Uses: Tool handles, veneer, turnery, carvings.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
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TARRIETIA UTILIS
and T. DENSIFLORA

NIANGON

Family: Sterculiaceae

Other Common Names: Nyankom (Ghana), Ogoué (Cameroon),
De-orph (Liberia), Yawe (Sierra Leone).

Distribution: West Africa from Sierra Leone to Ghana
(T. utilis), Cameroon and Gabon (T. densiflora).
Found in the lowlands as well as hilly areas.

THE TREE May reach a height of 100-130 ft; bole usually straight
and clear to 65 ft, sometimes irregular; trunk
diameter 2-3 ft, buttressed, frequently stilt rooted
in swampy areas.

THE WOOD General Characteristics: Heartwood pale pink- to red-brown,
darkening on exposure; sapwood up to 3 in. wide,
whitish, not always clearly demarcated. Grain generally
interlocked, sometimes wavy; texture somewhat coarse;
luster medium to low; greasy feel; figured on radial
surfaces due to high wood rays.

Weight: Basic specific gravity (ovendry weight/green volume)
T. utilis 0.54, T. densiflora 0.63; air-dry density
respectively 39 and 48 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	10,200	1,220	5,300
12%	13,000	1,380	7,500
12% (3)	17,600	1,830	8,500

Janka side hardness 1,050 lb for green material
and 1,100 lb for dry. Amsler toughness 236 in.-lb
at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly and well (T.
densiflora seasons slowly) sometimes with a tendency to
twist. Kiln schedule T6-D2 is suggested for 4/4 stock
and T3-D1 for 8/4. Shrinkage green to 12% moisture
content: radial 2.5%; tangential 4.5%. Movement in
service is rated as medium.

Working Properties: Works rather easily with hand and machine
tools with only moderate blunting, a cutting angle of
15 degrees is suggested when planing to prevent tearing,
excess gum may cause finishing problems, good gluing
properties.

Durability: Heartwood is rated as durable; sapwood liable
to powder-post beetle attack.

Preservation: Heartwood is extremely resistant; sapwood
resistant.

Uses: Furniture components, carpentry and joinery, boat-
building, greenhouses.

ADDITIONAL READING

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2. Farmer, R. H. (ed.).
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Office. London.
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Bois For. Trop. 76:45-54.

TERMINALIA IVORENSIS

IDIGBO

Family: Combretaceae

Other Common Names: Black Afara, Idigbo (Nigeria), Emeri (Ghana), Framiré (Ivory Coast).

Distribution: West tropical Africa from Guinea to Cameroon, abundant in primary and secondary forests and transition formations. A successful plantation species.

THE TREE Reaches a height of 150 ft, bole straight and clear to 70 ft, frequently fluted; trunk diameters 3-5 ft above buttresses. Brittleheart common.

THE WOOD General Characteristics: Heartwood yellow-brown or light pink-brown; sapwood somewhat paler, not clearly demarcated. Texture medium to rather coarse; grain straight or slightly irregular; moderately lustrous; without distinctive odor or taste. Dust may irritate skin or respiratory tracts. Timber may stain in contact with iron. Yellow dye may stain damp fabrics.

Weight: Basic specific gravity (ovendry weight/green volume) 0.43; air-dry density 32pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
12% (2)*	12,100	1,350	6,930
12% (3)	11,900	1,360	6,400

Janka side hardness 845 lb for dry material.
Amsler toughness 140 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly and well with little degrade. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4 stock. Shrinkage green to ovendry: radial 3.5%; tangential 5.2%; volumetric 9.0%. Movement in service rated as small.

Working Properties: Easy to work with hand and machine tools, a 20 degree cutting angle is suggested to avoid tearing of grain in planing, turns well, good nailing and gluing properties, takes a good finish.

Durability: Heartwood is rated as durable and moderately resistant to termite attack; sapwood liable to powder-post beetles.

Preservation: Heartwood highly resistant to preservative treatments; sapwood moderately resistant.

Uses: A good general purpose timber. Furniture components, joinery, decorative paneling, veneers, flooring, light construction.

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2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. France: Bois For. Trop.
1974. Framiré [Terminalia ivorensis]. Bois For. Trop. 153:23-33.

TERMINALIA SUPERBA

AFARA
LIMBA

Family: Combretaceae

Other Common Names: Ofram (Ghana), Fraké (Ivory Coast), Afara (Nigeria), Akom (Cameroon), Limba (Zaire, Angola). "Korina" a trade name in the U.S.A.

Distribution: Widely distributed from Sierra Leone to Angola and Zaire; occurs in rain and savanna forests. A favored plantation species in West Africa.

THE TREE Reaches a height of 150 ft; boles straight and clear to 90 ft; trunk diameters 4-8 ft above buttresses. Brittleheart present in some logs.

THE WOOD General Characteristics: Heartwood yellow-brown, sometimes with nearly black markings producing an attractive figure; sapwood not distinct from heartwood. Texture moderately coarse; grain straight to irregular or interlocked; slightly lustrous; mild odor. Dark colored figured wood is marketed separately as Dark Afara or Dark Limba. Splinters may cause skin inflammation.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45; air-dry density 34pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	12,100	1,530	5,490
12% (3)	13,200	1,430	6,900

Amsler toughness 127 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons rapidly with little or no checking and warp. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 4.5%; tangential 6.2%; volumetric 10.8%. Movement in service is rated as small.

Working Properties: Saws easily, works well with hand and machine tools, good veneering properties, good gluing and nailing characteristics, takes a good finish.

Durability: Heartwood is nondurable, not resistant to termites, liable to severe ambrosia beetle and powder-post beetle attack.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood moderately so.

Uses: Plywood, furniture, interior joinery, sliced for decorative veneers.

ADDITIONAL READING

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TESTULEA GABONENSIS

IZOMBÉ

Family: Ochnaceae

Other Common Names: Aké, Akewe (Gabon).

Distribution: Gabon and Cameroon; scattered distribution in dense primary forests and transitional formations.

THE TREE Reaches a height of 120 ft; bole straight, cylindrical and clear to 30-60 ft; trunk diameters 3-4 ft over thick buttresses.

THE WOOD General Characteristics: Heartwood orange-, gray-, or pink-yellow with a gray hue; sapwood not well demarcated. Texture very fine and even; grain straight.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.60; air-dry density 46 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
12% (3)*	17,500	1,520	9,800
12% (3)	13,800	1,830	8,050

Amsler toughness 116 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries easily with little or no degrade. No information on kiln schedules. Shrinkage green to oven dry: radial 3.4%; tangential 6.0%; volumetric 10.4%.

Working Properties: Saws well and works easily with hand and machine tools, easy to glue and nail, takes a good finish.

Durability: Heartwood has high durability and is resistant to termites. Sapwood is liable to stain. Satisfactory weathering properties.

Preservation: Heartwood is resistant to impregnation.

Uses: Millwork (door and window framing), furniture, flooring, turnery, carving.

ADDITIONAL READING

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TETRABERLINIA TUMANIANA

EKOP

Family: Leguminosae

Other Common Names: Sikon, Gola (Liberia).

Distribution: Known, presently, only from Liberia; occurs in evergreen rain forests, often in large concentrations.

THE TREE May reach a height of 100-150 ft; boles straight, cylindrical, and clear to 70 ft; trunk diameters to 4 ft.

THE WOOD General Characteristics: Heartwood pale red or red-brown; sapwood 1-2 in. wide, grayish with a pinkish tint, clearly demarcated. Texture medium to coarse; grain interlocked; medium luster; has an attractive figure.

Weight: Basic specific gravity (ovendry weight/green volume) 0.60; air-dry density 46pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
14% (3)*	16,750	2,210	9,010

*See "Additional Reading" for reference.

Drying and Shrinkage: Timber dries fairly slowly with a marked tendency to end and surface check. No information on kiln schedules. Shrinkage green to oven-dry: radial 5.6%; tangential 10.2%.

Working Properties: Works well with hand and machine tools, some tearing of grain when planing quartersawn faces, excellent turnery, slices well into veneers, good gluing properties.

Durability: Heartwood durability is only moderate; sapwood is liable to powder-post beetle attack.

Preservation: Heartwood is moderately resistant, sapwood permeable.

Uses: A general utility wood, veneer and plywood, furniture components, turnery.

ADDITIONAL READING

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3. Kukachka, B. F.
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TIEGHEMELLA HECKELII
and T. AFRICANA

MAKORÉ
DOUKA

Family: Sapotaceae

Other Common Names: (T. heckelii) Baku (Ghana), Makoré (Ivory Coast); (T. africana) Douka, Ukola (Gabon).

Distribution: Both species together are found from Sierra Leone to Cameroon, Gabon, and south to Cabinda; widely distributed in the high rain forests.

THE TREE Reaches a height of 180-200 ft; boles straight, cylindrical, and clear to 100 ft, free of buttresses; trunk diameters generally about 4 ft but may be up to 10 ft.

THE WOOD General Characteristics: Heartwood pink to pink- or red-brown; sapwood 2-3 in. wide, whitish or light pink, clearly demarcated. Texture fine to medium; grain generally straight; lustrous; sometimes with an attractive moiré figure. Liable to stain in contact with iron when damp.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.55; air-dry density 42 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	10,900	1,190	5,300
12%	14,700	1,470	7,730
12% (<u>4</u>)	17,400	1,630	9,700
12% (<u>4</u>)	16,000	1,460	8,100

Janka side hardness 930 lb for green material and 1,110 lb for dry. Amsler toughness 126 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries at a slow to moderate rate with little degrade. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4 (T. heckelii). Shrinkage green to ovendry: radial 4.7-6.2%; tangential 6.8-8.0%; volumetric 10.6-11.0%. Movement in service is rated as small.

Working Properties: A high silica content causes blunting of cutting edges, particularly in dry wood; works reasonably well with hand and machine tools, good veneering properties, finishes well, good gluing properties. Fine dust may irritate nose and throat or cause dermatitis.

Durability: Heartwood is highly durable and resistant to termite attack; sapwood liable to powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood moderately resistant.

Uses: Furniture, cabinetwork, joinery, decorative veneers, paneling, boatbuilding, flooring, turnery, marine plywood.

ADDITIONAL READING

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TRIPOCHITON SCLEROXYLON

OBECHE

Family: Sterculiaceae

Other Common Names: Arere, Obeche (Nigeria), Samba (Ivory Coast), Ayous (Cameroon), Wawa (Ghana), Abachi (Germany, Holland).

Distribution: Widely distributed in tropical West Africa from Guinea to Cameroon; predominantly along waterways and on abandoned farms in the transition zone between the humid evergreen and semideciduous forests.

THE TREE A large tree 150-180 ft in height, boles straight, cylindrical, and clear to 30 ft; buttresses may reach to 20 ft; trunk diameters to 5 ft.

THE WOOD General Characteristics: Timber whitish to pale straw with no difference between heartwood and sapwood. Texture medium to coarse; grain typically interlocked, giving a striped figure; lustrous; has an unpleasant smell when green but usually does not persist after drying.

Weight: Basic specific gravity (ovendry weight/green volume) 0.32; air-dry density 24 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	5,400	660	2,680
12%	7,900	800	4,090
12% (4)	8,800	940	4,300

Janka side hardness 420 lb for green material and 430 lb for dry. Amsler toughness 105 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries very rapidly and with little or no degrade, slight warp, though, may occur. Kiln schedule T14-C6S is suggested for 4/4 stock and T12-C5S for 8/4. Shrinkage green to ovendry: radial 3.0%; tangential 5.4%; volumetric 9.2%. Movement in service is rated as small.

Working Properties: Works very easily with hand and machine tools but sharp edges are needed for a smooth finish, veneers easily, good gluing and nailing properties.

Durability: Heartwood is not durable and liable to termite and other insect attack; sapwood prone to powder-post beetle attack. Logs must be extracted from the forest and converted rapidly to avoid deterioration by fungi and insects.

Preservation: Heartwood is resistant to preservative treatments; sapwood is permeable.

Uses: Furniture components, plywood, joinery, millwork, boxes and crates, blockboard, particle and fiberboard, patternmaking, artificial limbs.

ADDITIONAL READING

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TURREANTHUS AFRICANUS

AVODIRÉ

Family: Meliaceae

Other Common Names: Blimah-pu (Liberia), Apapaye (Ghana), Lusamba (Zaire), Apaya (Nigeria).

Distribution: From Sierra Leone to the Congo region and Angola; most common in the eastern region of the Ivory Coast, scattered elsewhere. Found near streams and lakes.

THE TREE Reaches a height of 115 ft; bole usually irregular, clear to 50 ft; fluted; trunk diameter 2-3 ft.

THE WOOD General Characteristics: Heartwood creamy-white to pale yellow, darkening to a golden-yellow; sapwood not differentiated. Texture moderately fine, grain straight, wavy, or irregularly interlocked; high natural luster; has an attractive mottled figure if quartered.

Weight: Basic specific gravity (ovendry weight/green volume) 0.48; air-dry density 36pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	13,400	1,390	7,450
12% (4)	19,200	1,750	8,800
12% (3)	14,400	--	7,050

Janka side hardness 1,080 lb for dry material. Amsler toughness 160-220 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries fairly rapidly with some tendency to warp, existing end checks are liable to extend. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.6%; tangential 6.7%; volumetric 12.0%. Movement in service is rated as small.

Working Properties: Timber saws well and easy to work with hand and machine tools, in planing a cutting angle of 15-20 degrees is suggested to avoid tearing of interlocked grain, good gluing and veneering properties. Dermatitis, nosebleeding, and other symptoms reported in woodworkers.

Durability: Heartwood is nondurable; reported to be moderately resistant to nonresistant to termite attack.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood permeable.

Uses: Furniture, fine joinery, decorative veneers, cabinet-work, paneling.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.
4. Sallenave, P.
1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

UAPACA spp.

SUGAR-PLUM

Family: Euphorbiaceae

Other Common Names: Abo emido, Yeye (Nigeria), Rikio, Borikio, Rikio rivière (Ivory Coast, Cameroon).

Distribution: Tropical areas of West Africa, mostly in swampy regions but may also border on the savanna.

THE TREE May reach a height of 90 ft; bole generally straight and may be 40 ft in length; trunk diameters 2-3 ft; high stilt roots.

THE WOOD General Characteristics: Heartwood pale red, red-brown, or chocolate-brown; sapwood paler, usually not clearly demarcated. Texture mostly medium to coarse; grain generally straight; little luster. High silica content.

Weight: Basic specific gravity (ovendry weight/green volume) 0.54-0.65; air-dry density 40-52 pcf.

Mechanical Properties: (2-cm standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	15,300	1,600	7,400
12% (2)	15,300	--	8,050
12% (2)	20,400	2,580	8,200

Amsler toughness 150-265 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally care is required in seasoning, best results if quartersawn, logs should be converted soon after extraction to minimize shake and checking. No information on kiln schedules.

Shrinkage green to ovendry: radial 4.6-6.0%; tangential 9.3-11.4%; volumetric 13.2-16.0%.

Working Properties: Timber saws with some difficulty due to silica, generally finishes well and glues satisfactorily.

Durability: Heartwood moderately durable to highly so and moderately resistant to termite attack.

Preservation: Heartwood resistant to pressure treatments; sapwood mostly permeable.

Uses: Good fuel and charcoal wood, light construction, boatbuilding, flooring. Fruits are edible.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.
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1971. Propriétés physiques et mécaniques des bois tropicaux. Deuxième Supplément. Publ. Centre Tech. For. Trop.

VITEX DONIANA

VITEX

MERU-OAK

Family: Verbenaceae

Other Common Names: Mfuru, Mgwobe (Tanzania), Munyamazi, Muhamozi (Uganda).

Distribution: Widespread from tropical West Africa and extending eastward to Uganda, Kenya, and Tanzania; occurs in savanna and high rainfall areas.

THE TREE May reach a height of 95 ft, boles up to 35 ft in length, fluted at the butt; trunk diameters 2-5 ft.

THE WOOD General Characteristics: Wood is whitish or yellow-gray, sapwood and heartwood are not differentiated. Texture medium to coarse; grain wavy or slightly interlocked.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40; air-dry weight 30pcf.

Mechanical Properties: (2-in. standard).

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (2)*	5,950	750	3,900

Janka side hardness 680 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly with moderate to severe warp but little checking, develops collapse. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 1.1%; tangential 3.3%. Movement in service is rated as small.

Working Properties: Works easily with hand or machine tools, drills easily but leaves a rough surface, nails well, too soft for good turnery, veneers well. Dust may cause dermatitis.

Durability: Heartwood is perishable; sapwood liable to stain.

Preservation: Wood is rated as moderately resistant to preservative treatments.

Uses: Boxes and crates, utility furniture, joinery.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Bryce, J. M.
1967. The commercial timbers of Tanzania. Tanzania For. Div. Util. Sec. Moshi.
3. Tanzania: Util. Div. For. Dep.
1966. Timbers of Tanganyika: Vitex doniana (Mfuru). Util. Sec. For. Div. Moshi.

WIDDRINGTONIA WHYTEI

MLANJE-CEDAR

Family: Cupressaceae

Other Common Names: Mlanje cypress, Mkungusa (Nyasaland).

Distribution: South and southeast Africa, Malawi, Rhodesia, Mozambique; plantations established in Tanzania and Kenya. Occurs in ravines and upper plateaus at elevations of 6,000-7,000 ft.

THE TREE Reaches a height of 140 ft; bole clear to 70 ft; trunk diameters up to 5 ft.

THE WOOD General Characteristics: Heartwood yellowish or light brown; sharply defined from the narrow paler sapwood. Texture fine; grain straight; distinct cedarlike odor; satiny luster.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.45; air-dry density 34 pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Reported to have good seasoning properties.

Working Properties: Saws readily and works well with all tools, glues satisfactorily, nails and screws well.

Durability: Heartwood is very durable and highly resistant to termite attacks. Natural oiliness preserves without need for paint.

Preservation: No information.

Uses: Pencil slats, interior millwork, furniture, shingles, light construction, paneling, flooring.

ADDITIONAL READING

1. Bolza, E., and W. G. Keating.
1972. African timbers--the properties, uses, and characteristics of 700 species. CSIRO. Div. of Build. Res. Melbourne, Australia.
2. Dallimore, W., and A. P. Jackson.
1966. A handbook of Coniferae and Ginkgoaceae. Rev. by S. G. Harrison. 4th Ed. Edward Arnold. London.

Individual Data Sheets for
Species by Region of Origin:
Southeast Asia and Oceania (AS)

ACACIA MELANOXYLON

AUSTRALIAN BLACKWOOD

Family: Leguminosae

Other Common Names: None.

Distribution: Eastern Australia from Queensland southward to Victoria and also in Tasmania. Introduced into East and South Africa, India, Ceylon, Chile, and Argentina.

THE TREE Reaches a height of 100 ft with trunk diameters up to 3 ft.
Many stems are buttressed, defective, or irregular and, in the open, boles are rarely clear for more than 12 to 14 ft.

THE WOOD General Characteristics: Heartwood golden to dark brown, sometimes with a reddish tinge; dark streaks mark the growth zones; sharply demarcated from the straw-colored sapwood. Lustrous; texture fine to medium; grain usually straight, sometimes interlocked or wavy; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 40 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	10,400	1,710	4,880
12%	15,900	2,050	8,420
12% (<u>3</u>)	14,600	2,210	--

Janka side hardness 950 lb for green material and 1,100 lb at 12% moisture content. Forest Products Laboratory toughness 146 in.-lb for green material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Australian grown wood is reported to be easily seasoned without degrade. Wood grown in Tanganyika had negligible checking and splitting but with a marked tendency to cup. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to oven-dry: radial 3.4%; tangential 9.0%. Movement in service is reported as medium.

Working Properties: The timber is easy to work with hand or machine tools; can be steam bent easily down to a 3-in. radius; glues and stains well and can be highly polished.

Durability: Durability of heartwood is reported as intermediate and is readily attacked by termites; sapwood is moderately susceptible to lyctus attack.

Preservation: Heartwood is reported as not treatable using either open tank or pressure systems. Moderately heavy vessel penetration is obtained in the sapwood.

Uses: Fine furniture and cabinet wood, fancy veneers, interior joinery, bentwork, turnery, tight cooperage, gunstocks, musical instruments.

ADDITIONAL READING

1. Australia: For. Prod. News-Lett.
1963. Acacia melanoxylon. Properties of Australian timbers: Blackwood. For. Prod. News-lett. CSIRO. Aust. No. 295.
2. Bolza, E., and N. H. Kloot.
1963. The mechanical properties of 174 Australian timbers. Div. For. Prod. Technol. Pap. For. Prod. Aust. No. 25.
3. Tanganyika: Util. Div. For. Dep.
1963. Timbers of Tanganyika Acacia melanoxylon (Australian Blackwood). Utilization Section, Forest Division, Moshi.

ACACIA MOLLISSIMA
SYN. A. MEARNSSII

BLACK WATTLE

Family: Leguminosae

Other Common Names: None.

Distribution: Native to Australia but extensively planted in East and South Africa and elsewhere.

THE TREE A small tree 20 to 50 ft high.

THE WOOD General Characteristics: Heartwood pale brown with a pinkish tinge; not sharply demarcated from the sapwood. Grain commonly interlocked; luster medium; texture moderately fine and uniform; without distinctive odor or taste.

Weight: basic specific gravity (ovendry weight/green volume) 0.60; air-dry density 45 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,550	1,620	5,170
12%	17,500	2,080	8,800

Janka side hardness 1,280 lb for green material and 1,750 lb at 12% moisture content.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly but with pronounced warp, particularly cupping. Shakes tend to open and knots to split slightly. Kiln schedule T2-D⁴ is suggested for 4/4 stock and T2-D3 for 8/4. No data on shrinkage available but reported to have a large movement.

Working Properties: No data available on machining characteristics but tests in Australia indicate its suitability for cutting into veneer.

Durability: Heartwood nondurable; sapwood vulnerable to *lyctus* beetle attack.

Preservation: Reported to be moderately resistant to preservative treatments.

Uses: Mining props, flooring parquet and strips, hardboard. Mainly cultivated for the rich tannin content of the bark, reaching 40 to 50%.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Lavers, G. M.
1967. The strength properties of timbers. Forest Products Research Bulletin No. 50. H. M. Stationery Office.
London.

ADINA CORDIFOLIA

HALDU
KWAO

Family: Rubiaceae

Other Common Names: Hnaw (Burma), Kwo, Kwow, Kan-luang (Thailand), Kovao, Gáo (Cambodia).

Distribution: India, Ceylon, Thailand, and Burma; scattered in mixed deciduous forests.

THE TREE A large tree reaching a height of 100 ft with trunk diameters of 4 to 5 ft; long, straight, fluted stem which is sometimes buttressed.

THE WOOD General Characteristics: Heartwood yellow when freshly cut, turning pale yellowish or reddish-brown on exposure; not sharply demarcated from the yellowish-white rather thick sapwood. Lustrous; fairly straight-grained but sometimes interlocked; texture fine and even; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies from 0.54 to 0.63, depending on source; air-dry density 41 to 48 pcf.

Mechanical Properties: (First set of values based on the 2-in. standard, second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
15% (2)*	12,230	1,340	6,040
12% (3)	13,000	--	8,600

Janka side hardness 1,140 lb at 15% moisture content. Amsler toughness 133 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Some tendency to check and split in air drying; otherwise reported to season fairly well. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 3.4%; tangential 6.8%. Reported to have a large movement in service.

Working Properties: Easy to work with hand and machine tools; turns well; takes a very fine and smooth finish.

Durability: Reports vary from moderately durable to nondurable.

Preservation: No information available.

Uses: Joinery, turnery, furniture, decorative paneling, bobbins, flooring.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central
Publ. Br., Calcutta.
3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois
tropicaux de l'union Francaise. Publ. Centre Tech.
For. Trop. No. 8.

AGATHIS SPP.

KAURI

Family: Araucariaceae

Other Common Names: Dakua makadre (Fiji), Kauri pine (New Zealand), Bindang (Sarawak), Menghilan (Sabah), Damar minyak (Malaya), Tolong (Brunei), Almaciga (Philippines).

Distribution: Widely distributed in Indo-China, Malaysia, Indonesia, Philippines, and extending to New Guinea, New Zealand, and Fiji. Found from sea level to high altitudes.

THE TREE Varies with species but may reach a height of 200 ft with trunk diameters of 5 to 7 ft, sometimes reaching 10 ft and more. Boles are straight, cylindrical, without buttresses, and clear for long lengths.

THE WOOD General Characteristics: Heartwood pale cream, golden-brown, to dark reddish- or yellowish-brown if resinous; usually not distinct from the sapwood. Lustrous; grain mainly straight; texture fine and uniform; generally without distinctive odor or tastes (*A. australis* has a faint pleasant odor).

Weight: Basic specific gravity (ovendry weight/green volume) 0.41 to 0.47; air-dry density 30 to 36 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	6,600	1,330	2,840
12%	11,750	1,650	5,900
Green (1)	7,790	1,570	3,370
12%	13,070	1,890	5,600
Green (3)	8,570	1,400	4,040
12%	13,600	1,600	6,900

Side hardness 480 to 760 lb for green material and 700 to 870 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: The timber is reported to season well with little or no degrade. Kiln schedule T7-B3 is suggested for 4/4 stock (A. alba) and kiln schedule T10-D5S for 4/4 stock (A. australis and A. vitiensis). Shrinkage green to ovendry: radial 4.2%; tangential 6.0% (A. alba).

Working Properties: The timber works easily with hand and machine tools, finishes with a clean smooth surface; good nailing and screwing properties; good veneer peeling characteristics; paints and polishes well; easy to glue.

Durability: Generally reported to be nondurable and vulnerable to termite attack; prone to blue stain. Heartwood of A. australis is moderately durable in ground contact.

Preservation: Usually treatable by standard preservation techniques.

Uses: Vats and tanks, patternmaking, millwork, boatbuilding, furniture components, face veneers, shingles, pencil slats. Trees are tapped for its copal used in varnishes and lacquers (A. alba).

ADDITIONAL READING

1. Entrican, A. R., rev. by J. S. Reid.
1949. The properties and uses of Kauri (Agathis australis).
Inform. Ser. N.Z. For. Serv. No. 7.
2. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
3. Lavers, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.
4. UK: Dept. Sci. Ind. Res.
1957. A handbook of softwoods. H. M. Stationery Office. London.

ALBIZIA FALCATARIA
SYN. A. FALCATA

BATAI
MOLUCCA ALBIZZIA

Family: Leguminosae

Other Common Names: Puah (Brunei), Moluccan sau (Philippines).

Distribution: Native to the Molucca Islands of Indonesia and introduced throughout the tropics. A favored species for plantations in the Philippines and Malaysia.

THE TREE Plantation-grown trees in stands 36 years old had heights that ranged from 84 to 145 ft; trunk diameters ranged from 19 to 32 in.; and clear merchantable boles ranged from 58 to 82 ft.

THE WOOD General Characteristics: Heartwood light brown with a slight pinkish or yellowish tinge; not clearly demarcated from the sapwood. Texture rather coarse; grain usually deeply interlocked; sometimes lustrous; dried material without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.32; air-dry density 24pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	5,300	1,080	2,610
12%	8,400	1,280	4,490

Janka side hardness 360 lb for green material and 450 lb at 12% moisture content. Forest Products Laboratory toughness 250 in.-lb for green material and 185 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber dries rapidly with little or no degrade. No data available on kiln schedules. Shrinkage green to oven dry: radial 3.2%; tangential 6.2%; volumetric 9.5%. Movement in service is reported to be small.

Working Properties: Reported to dull cutters rather quickly; fuzzy grain is rather common because of tension wood. Saws well but growth stresses often cause pinching of the blade. Sharp tools are required to cut this softwood cleanly. Dust from machining may be irritating.

Durability: The wood is not durable and is vulnerable to attack by termites and powder-post beetles. Lumber stains rather rapidly.

Preservation: Sapwood is easy to treat, heartwood absorptions of about 5 pcf are obtainable using an open tank system.

Uses: Veneer core stock, pallets and crating, furniture components, pulp and paper, fiberboard and particleboard.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Gerhards, C. C.
1966. Physical and mechanical properties of Molucca albizia grown in Hawaii. USDA Forest Service Res. Pap. Fpl 55. Forest Prod. Lab., Madison, Wis.
3. Skolmen, R. G.
1974. Some woods of Hawaii. . . properties and uses of 16 commercial species. USDA General Technical Report PSW-8. Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

ALBIZIA LEBBEK

KOKKO

Family: Leguminosae

Other Common Names: Dormilón (Colombia), Barba de caballero (Venezuela), Siris tree, East Indian Walnut (United Kingdom), Siris (India).

Distribution: The species is widely distributed in India, Burma, Andaman Islands, Philippines, Indochina, and Malaysia. Planted and naturalized throughout the tropics as an ornamental and for shade.

THE TREE Under favorable conditions reaching a height of 90 ft with trunk diameters of 2 to 3 ft. The crown is usually spreading. Grows particularly well in dry areas.

THE WOOD General Characteristics: Heartwood golden-brown when freshly cut turning to a rich dark brown with lighter streaks on exposure; distinct from the whitish sapwood. Texture medium to coarse; luster medium; grain deeply interlocked; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.51; air-dry density 39 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 8%	9,500 14,400	1,580 1,820	5,100 8,750
11% (<u>3</u>)	15,640	2,060	10,300
12% (<u>4</u>)	13,400	--	7,950

Janka side hardness ranged from 1,240 lb to 1,440 lb for dry material. Amsler toughness at 12% moisture content 210 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: A moderately difficult wood to air dry, prone to end splitting and surface checking. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.9%; tangential 5.8%; volumetric 9.6%.

Working Properties: The wood is reported to be somewhat difficult to saw and machine because of the roey grain; takes a smooth surface and finishes well; slices well for decorative veneers. Sawdust may be irritating to eyes, nose, and throat.

Durability: Heartwood is rated as moderately durable.

Preservation: Sapwood is easy to treat, heartwood is not.

Uses: Furniture and cabinetwork, decorative veneers, parquet and strip flooring, joinery.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
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2. For. Res. Inst. and Colleges.
1970. Indian timbers. Kokko (Siris). For. Res. Inst.
and Colleges Information Series 6. Dehra Dun.
3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India
Central Publ. Br., Calcutta.
4. Sallenave, P.
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tropicaux de l'union Francaise. Publ. Centre
Tech. For. Trop. No. 8.

ALSTONIA spp.

PULAI

Family: Apocynaceae

Other Common Names: Milkwood (Papua New Guinea), Dita (Philippines), Shaitan wood (India), Mo Cua (Vietnam), Basong (Malaya), Mergalang (Sarawak), Milky pine, White cheesewood (Australia).

Distribution: Throughout the Indo-Malayan region, Australia, and Polynesia. Varying with species, found on dry land and swampy sites.

THE TREE Clear straight boles 40 to 50 ft in length, sometimes reaching 90 ft; diameters commonly 3 to 4 ft. Stems are characteristically fluted; sometimes buttressed.

THE WOOD **General Characteristics:** Sapwood yellowish-white to pale brown; not differentiated from heartwood; texture moderately fine to somewhat coarse; grain mostly straight, sometimes interlocked; quite lustrous; without characteristic odor or taste when dry. Has large slit-like latex canals.

Weight: Basic specific gravity (ovendry weight/green volume) 0.34 to 0.40; air-dry density 25 to 30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)* 6%	5,130 7,480	900 1,060	2,790 4,560
Green (<u>3</u>)	5,800	960	3,120

Janka side hardness 380 lb for green material and 460 lb for dry. Green Forest Products Laboratory toughness 179 in.-lb (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood is reported to be easy to air dry with little or no degrade. Kiln schedule T10-D4S is suggested for 4/4 stock. Shrinkage green to ovendry: radial 3.4%; tangential 6.1%.

Working Properties: Very easy to work by hand and machine tools; cuts smoothly; turns well. Veneers easily peeled on a rotary lathe. Nails well.

Durability: Prone to stain, decay, and insect attack. Very susceptible to attack by powder-post beetles.

Preservation: At least one species is reported to absorb preservatives very readily.

Uses: Patternmaking, boxes and crates, carving, veneer and plywood, interior trim, furniture components. Root wood of A. spathulata once used for "pith" helmets.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan Forest Records 15. 2 vol.
3. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
4. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

AMOORA SPP.

AMOORA
THITNI

Family: Meliaceae

Other Common Names: Ta-sua (Thailand), Kato, Malatumbaga (Philippines), Bekak (Malaysia), Thitni (Burma), Amoora, Amari (India).

Distribution: India, Burma, Malay Peninsula, Philippines, and Sabah. Widely distributed but seldom very abundant in the Sub-Himalayan regions.

THE TREE Sometimes reaching a height of 100 ft; with diameters commonly 2 to 3 ft. Boles straight and cylindrical, up to 50 ft in length.

THE WOOD **General Characteristics:** Heartwood light to dark red, reddish brown or walnut-brown; sharply defined from the straw to pinkish sapwood. Grain straight to somewhat interlocked; texture mostly medium to coarse; luster variable; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species from 0.44 to 0.76; air-dry density 33 to 58 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	--	--	4,330
12%	--	--	7,550

Janka side hardness 755 lb for green material and 895 lb at 12% moisture content. Forest Products Laboratory toughness 230 in.-lb and 190 in.-lb for green and dry material (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to be easy to air season, even in wide boards. No data on kiln schedules or shrinkage values available.

Working Properties: Saws and works well with both hand and machine tools; turns easily; takes a smooth finish.

Durability: Generally reported to be moderately durable when exposed to the weather or in ground contact.

Preservation: No information available.

Uses: Furniture and cabinetwork, flooring, construction, joinery, turnery, veneer and plywood.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan Forest Records 15. 2 vol.
3. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
4. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br. of Calcutta.

ANISOPTERA spp.

MERSAWA
PALOSAPIS

Family: Dipterocarpaceae

Other Common Names: Pengiran (Sabah), Palosapis (Philippines), Kaunghmu (Burma), Phdiek (Cambodia), Mersawa (Malaysia), Krabak (Thailand), Ven-ven (Indochina).

Distribution: From Burma, throughout the Malayan region, Philippines, and New Guinea.

THE TREE Commonly 100 to 150 ft in height sometimes reaching 200 ft; 3 to 5 ft in diameter; boles are well formed and with or without buttresses depending on species.

THE WOOD **General Characteristics:** Heartwood pale yellow or light yellow-brown, sometimes with a pinkish tinge, darkening on exposure; sapwood lighter but not sharply demarcated. Texture moderately coarse; grain interlocked; not lustrous; without distinctive odor or taste when dry; silica ranging from 0.24 to 1.37% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.46 to 0.62; air-dry density 34 to 47 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, the third on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 12%	7,850 13,500	1,735 2,220	3,880 7,220
Green (<u>4</u>) 12% (<u>3</u>)	8,130 18,100	1,580 1,720	4,150 8,400

Janka side hardness 725 lb for green material and 875 lb at 12% moisture content. Forest Products Laboratory toughness 236 in.-lb for green material and 308 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Lumber dries very slowly, particularly the core of thick stock, with little degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 3/4. Shrinkage green to oven-dry: radial 4.0%; tangential 9.0%; volumetric 14.6%. Movement in service is rated as medium.

Working Properties: The timber can be worked to a good finish but there is considerable dulling of cutters due to the silica content. Carbide-tipped tools are suggested.

Durability: Generally classified as moderately resistant to attack by decay fungi and nonresistant to termites. Sapwood is particularly vulnerable to powder-post beetles and stain.

Preservation: Heartwood is reported to be difficult to impregnate; both open tank and pressure-vacuum systems gave less than 3 pcf of preservative absorption.

Uses: Veneer and plywood, joinery, furniture components, flooring, light construction.

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ANTHOCEPHALUS CHINENSIS
SYN. A. CADAMBA

KADAM

Family: Rubiaceae

Other Common Names: Kalempayan (Malaya), Laran (Sabah), Kaatoan Bangkal (Philippines), Kelempajan (Indonesia), Mau-lettan-she (Burma), Kadam (India).

Distribution: Widely distributed from India to the Malayan Peninsula, Indonesia, Philippines, New Guinea, and Australia. Grows best on deep, moist, alluvial sites, often in secondary forests along riverbanks. A favored plantation species inside and outside its native region.

THE TREE May reach a height of 150 ft with trunk diameters of 40 in.; but more commonly 50 to 100 ft in height with diameters of 15 in. to 24 in.; sometimes with small buttresses; broad crown.

THE WOOD General Characteristics: Sapwood white with a light yellow tinge becoming creamy yellow on exposure; not differentiated from the heartwood. Texture fine to medium; grain straight; luster low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.31 to 0.40; air-dry density 23 to 30 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	6,870	1,170	3,370
12%	10,980	1,270	5,750
Green (<u>3</u>)	5,000	735	2,340
Green (<u>5</u>)	7,850	1,100	4,020
12%	11,150	1,260	6,440

Janka side hardness 470 lb green and 600 lb at 12% moisture content. Forest Products Laboratory toughness 157 in.-lb for green material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The timber air dries rapidly with little or no degrade. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 2.5%; tangential 5.9%. Movement in service is rated as small.

Working Properties: The wood is easy to work with hand and machine tools, cuts cleanly, gives a very good surface. Easy to nail.

Durability: The wood is rated as nondurable.

Preservation: Very easy to treat using either open tank or pressure-vacuum systems.

Uses: Plywood, light construction, pulp and paper, boxes and crates, furniture components, millwork.

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ARAUCARIA SPP.

HOOP-PINE

KLINKI-PINE

Family: Araucariaceae

Other Common Names: Pin colonnaire, Sapin de montagne (New Caledonia), Norfolk Island Pine (Norfolk Island), Bunya-bunya, Hoop Pine (Australia).

Distribution: Australia, New Guinea, New Caledonia, New Hebrides, and Norfolk Island. Planted as an ornamental elsewhere.

THE TREE Varies with species but commonly 150 ft in height with trunk diameters of 3 ft. Trees over 250 ft in height and diameters over 6 ft are reported. Plantation-grown trees in Hawaii reached a height of 90 ft and a diameter of 18 in. in 40 to 50 years.

THE WOOD General Characteristics: Heartwood light yellowish-brown, occasionally with a pinkish tinge; not sharply demarcated from the straw-colored sapwood. Growth rings inconspicuous; lustrous; texture fine and even; grain typically straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.42; air-dry density 31 pcf.

Mechanical Properties: (First set of data based on the 1-in. standard, second and third sets on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	7,100	1,410	3,170
12%	11,000	1,560	5,840
Green (1)	6,890	1,410	3,760
12%	13,100	1,880	7,060
Green (3)	6,120	1,460	3,170
12%	11,100	1,730	6,370

Janka side hardness 500 lb for green material and 650 lb at 12% moisture content. Forest Products Laboratory toughness 175 in.-lb for green material and 125 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The timber is easy to air season with little or no degrade. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 3.5%; tangential 5.3%; volumetric 8.9%. Movement in service is small.

Working Properties: The wood is easy to work with hand and machine tools; dense small knots are common and cause some torn and chipped grain in planing. Easy to nail and glue.

Durability: The timber is nondurable; sapwood is vulnerable to blue stain.

Preservation: The wood is reported to be easily treated.

Uses: Interior joinery, boxes, flooring, veneer and plywood, light construction, furniture components, patterns, pulp and paper.

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Island-Pine" grown in Hawaii. USDA Forest Service
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ARTOCARPUS SPP.

KELEDANG

Family: Moraceae

Other Common Names: Ainee, Lakuch (India), Antipolo, Anubing (Philippines), Beruni, Terap (Sabah), Selangking (Sarawak), Ma-hat (Thailand).

Distribution: The genus is widely distributed in Indo-Malaya. The bread and jackfruits are cultivated throughout the tropics.

THE TREE Trees reach a height of 100 ft, with trunk diameters commonly 2 to 4 ft; boles are straight and cylindrical.

THE WOOD General Characteristics: Heartwood yellow to brown, sometimes with an olive-green tinge, some species turning dark brown upon exposure; sapwood sharply defined in some species; texture moderately coarse to coarse; grain interlocked; moderately lustrous; without distinctive odor or taste. Vitreous silica content of up to 6.4% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.41 to 0.75; air-dry density 32 to 57 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 12%	8,300 12,300	980 1,260	4,400 6,550
13% (4)	13,300	1,706	8,260

Janka side hardness 1,210 lb for green material and 1,250 lb at 12% moisture content. Forest Products Laboratory toughness 268 in.-lb for green material and 209 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Varies with species, generally reported to season rather slowly with little to moderate warp and checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 2.9%; tangential 5.5%.

Working Properties: Some species reported to be difficult to saw and machine, others are easy to work and dress smoothly.

Durability: There is considerable variation in heartwood durability within and between species ranging from perishable in ground contact to highly durable.

Preservation: Heartwood absorption is low in most species, sapwood absorbs preservatives readily.

Uses: Flooring, joinery, furniture and cabinetwork, musical instruments, turnery, veneer and plywood, heavy construction (under cover).

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1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

AZADIRACHTA SPP.

NEEM
MARANGGO

Family: Meliaceae

Other Common Names: Ranggai (Sabah), Sentang (Malaya),
Ranggu (Sarawak), Tamaka (Burma).

Distribution: Throughout the Indo-Malayan regions, well distributed in lowland forests. Extensively planted as an ornamental and for shade in gardens and along roadsides in the tropics.

THE TREE With a clear cylindrical trunk about 20 to 45 ft in length; diameters of 3 to 5 ft; bole is sometimes fluted.

THE WOOD General Characteristics: Heartwood reddish-brown, darkening on exposure; sapwood straw-colored to pale red, not sharply demarcated. Texture moderately coarse; grain interlocked; dull to somewhat lustrous; has a faint cedar-like odor when fresh which fades on drying, no distinctive taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard, the second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	11,000 14,300	1,120 1,270	5,300 7,370
12% (<u>2</u>)	11,480	1,009	6,680

Janka side hardness 1,220 lb for green material and 1,460 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: The timber is reported to season well with little or no degrade. Kiln schedule T2-D⁴ is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to air dry: radial 2.2%; tangential 4.3%; volumetric 6.5%. Movement in service is rated as small.

Working Properties: Works well with hand and machine tools; a fine smooth finish is produced.

Durability: A. excelsa reported not resistant to decay while A. indica is rated as durable to moderately durable.

Preservation: Heartwood is not treatable but sapwood absorption is good using a pressure-vacuum system.

Uses: Veneer and plywood, furniture and cabinetwork, joinery, carving.

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BALANOCARPUS spp.

CHENGAL
PENAK

Family: Dipterocarpaceae

Other Common Names: Takien-chan (Thailand), Kong, Karakong (India), Mindanao Narek, Narek (Philippines).

Distribution: B. heimii is widely distributed in the Malay Peninsula including Thailand south of Pattani. Other species reported in India and the Philippines.

THE TREE Stem diameters over 3 ft. are common; boles mostly well-shaped and clear for 100 ft or more. A very large specimen with a diameter of 13 ft is reported.

THE WOOD General Characteristics: Heartwood light yellow-brown with a distinct green tinge when fresh, changing on exposure to a dark brown or dark purple-brown; sharply demarcated from the pale yellow sapwood. Luster moderate; grain usually only shallowly interlocked; texture fine and even; odor and taste not distinctive.

Weight: Basic specific gravity (ovendry weight/green volume) 0.76, air-dry density 58 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	17,680	2,630	10,000
16%	21,560	2,840	10,900

Janka side hardness 2,085 lb for green material and 2,130 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood is slow drying and prone to surface checking. Shrinkage is reported to be low. Kiln schedule T2-C2 is suggested for 4/4 stock. Air drying prior to kiln drying is recommended.

Working Properties: Easy to work with both hand and machine tools but there is some tendency for saws to gum up; planes to a smooth surface and takes a very good polish.

Durability: Heartwood is very resistant to insect and fungal attack; but is reported as vulnerable to marine borers.

Preservation: Heartwood is reported as not treatable.

Uses: Heavy construction, railroad crossties, boat building, utility poles, industrial flooring, vats, casks, and tanks.

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BEILSCHMIEDIA TAWA

TAWA

Family: Lauraceae

Other Common Names: None.

Distribution: New Zealand, native to all parts of North Island and northeast area of South Island; at altitudes from sea level to approximately 1,000 ft.

THE TREE Usually attains a height of 60 to 80 ft, with trunk diameters of 18 in. to 30 in. Boles are clear to 30 ft.

THE WOOD General Characteristics: Pale-colored grayish-brown wood sometimes with dark brown streaks; no sharp demarcation between sapwood and heartwood. Texture moderately fine; grain usually straight; luster low; without distinctive odor or taste. Silica content of 0.14% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.58; air-dry density 44 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)* 12%	9,690 15,730	1,590 2,060	4,390 8,370

Janka side hardness 990 lb for green material,
1,405 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Kiln and air dries readily with little or no degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to oven dry: volumetric 11.4%.

Working Properties: Works satisfactorily with both hand and machine tools; has a moderate blunting effect on cutters; tends to split in nailing. Glues well.

Durability: Heartwood is nondurable; sapwood vulnerable to powder-post beetle attack.

Preservation: Responds well to diffusion treatment as well as pressure-vacuum systems.

Uses: Flooring, joinery, furniture components, plywood, cooperage, turnery, doweling.

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BISCHOFIA JAVANICA

BISHOPWOOD

Family: Euphorbiaceae

Other Common Names: Gintungan, Paniala (India), Aukkyu, Ye-Padauk (Burma), Nhoi (Vietnam), Term (Thailand), Tuai (Philippines), Koka (Fiji).

Distribution: Widely distributed Indo-Malayan species extending into the Philippines, Korea, and Polynesia. Common along streams at low and medium altitudes.

THE TREE May reach a height of 100 ft but bole seldom attaining a length of 25 ft; trunk diameters of 36 in. and more are common, reaching 60 in.; without buttresses.

THE WOOD **General Characteristics:** Heartwood purple-red-brown, darkening to a much deeper shade on exposure; sapwood light cream-colored to reddish-brown, rather distinct from the heartwood. Texture moderately fine to rather coarse; grain interlocked; slightly lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) ranges from 0.45 to 0.71, averaging about 0.56; air-dry density $3\frac{1}{4}$ to $5\frac{1}{4}$ pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	6,920 16,000	860 1,630	3,610 7,130
Green (<u>2</u>) 10%	6,970 14,190	1,260 1,690	3,370 8,560

Janka side hardness 915 lb for green material and 1,370 lb for dry. Forest Products Laboratory toughness 244 in.-lb green and 113 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported as very difficult to season; severe warp and checking, tending to collapse and honeycomb. Material from Malaya reported to season rapidly with little degrade. No data on kiln schedules available. Shrinkage green to ovendry: radial 4.4%; tangential 9.8%.

Working Properties: Machining characteristics are rated as good, works to a smooth finish.

Durability: Heartwood moderately durable; but ratings vary from perishable in the Philippines to durable in the Fiji Islands.

Preservation: Reports from Malaya indicate heartwood is non-treatable but absorptions of 4 to 5pcf were obtained in tests at Dehra Dun, India.

Uses: General construction (protected from the weather), flooring, furniture components. Good quality Kraft and soda pulps were prepared from this wood.

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BUCKLANDIA POPULNEA

PIPLI

Family: Hamamelidaceae

Other Common Names: Dingdah, Pipli, Singliang (India), Gerok (Malaya).

Distribution: Eastern Himalayas, Assam, Lower Burma, and Malayan Peninsula; abundant in mountain forests.

THE TREE A rather large tree up to 5 ft in diameter with a straight cylindrical stem 40 ft in length. Tree heights of 150 ft and diameters of 7 ft are reported.

THE WOOD General Characteristics: Wood light reddish-brown to brown or grayish-brown; heartwood and sapwood not sharply differentiated. Texture fine and even; grain broadly interlocked; dull to somewhat lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.51; air-dry density 40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 12%	8,760 15,720	1,480 2,025	4,430 8,770
12% (<u>2</u>)	10,260	1,385	5,690

Janka side hardness 625 lb for green material and 1,145 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Air dries rather rapidly with only slight surface checking and slight end splitting. No data available on kiln schedules or shrinkage characteristics.

Working Properties: The timber is easy to saw and plane, turns easily on a lathe, finishes to an exceptionally smooth surface, and takes a good polish.

Durability: In Malaya, limited tests show severe decay after 3 years of ground contact. In India the wood is rated as fairly durable in exposed positions.

Preservation: No data available.

Uses: General carpentry, joinery, millwork, light construction, furniture components, used for tea chests in India.

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CALLITRIS GLAUCA
SYN. C. COLUMELLARIS

WHITE CYPRESS-PINE

Family: Cupressaceae

Other Common Names: Murray River Pine, Murray River Cypress, Cypress Pine, Murray Pine (Australia).

Distribution: Widely distributed throughout Australia with main commercial development in New South Wales and Queensland.

THE TREE The tree varies in size according to soil and climate conditions; on suitable sites may reach a height of 100 ft with diameters around 18 in. to 24 in.

THE WOOD General Characteristics: The timber is light brown in color with dark brown longitudinal streaks; sapwood varies from pale straw to pinkish-tan. Grain is usually straight; texture rather fine; lustrous; aromatic camphor-like odor; greasy feel; many tight, small, dark brown knots.

Weight: Basic specific gravity (ovendry weight/green volume) 0.58; air-dry density 42 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,300	1,110	5,220
12%	11,400	1,300	7,610

Janka side hardness 1,030 lb for green material and 1,375 at 12% moisture content. Forest Products Laboratory toughness 114 in.-lb green and 65 in.-lb dry (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood seasons readily but because of low shrinkage is customarily used in the green or partially dried condition; tends to check around knots. Shrinkage green to air dried: radial 2.1%; tangential 2.8%; volumetric 4.0%.

Working Properties: The timber is fairly easy to work although there is some tearing of grain around knots; dresses well to a smooth finish and takes a high polish; some tendency to split when nailed.

Durability: The heartwood is rated as very durable and is highly resistant to attack by both decay fungi and insects, including termites. High resistance to marine organisms is also reported.

Preservation: No information available.

Uses: Light construction including siding, flooring, and joinery, posts and poles, decorative veneer, furniture components.

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CALOPHYLLUM spp.

BINTANGOR

Family: Guttiferae

Other Common Names: Poon (India), Bitanghol, Bitaog (Philippines), Tamanou (New Caledonia), Penaga (Sabah), Ka thang han, Ka thang lan, Tang hon (Thailand), Damanu (Fiji Islands).

Distribution: The genus is widely distributed throughout Southeast Asia on sites that range from coastal and swamp to mountain forests.

THE TREE Trees generally to a height of 100 ft with trunk diameters of 2 ft, but may reach a height of 150 ft with a diameter of 5 ft. Boles are long, cylindrical, and often clear to 40 to 60 ft.

THE WOOD General Characteristics: Heartwood deep red, red-brown, pink-brown, or orange-red; sapwood yellow-brown with a pink or orange tinge, clearly defined. Texture coarse to moderately coarse, rather uneven; lustrous; grain interlocked; without distinctive odor or taste; figured by concentric irregular bands of parenchyma.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.40 to 0.65; air-dry density 31 to 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	8,450	1,240	4,090
12%	13,700	1,480	8,640
Green (2)	9,500	1,330	4,755
12%	13,255	1,705	7,165

Janka side hardness 1,040 lb for green material and 1,475 lb for dry. Forest Products Laboratory toughness 87 in.-lb for green material and 110 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Moderately difficult to air dry; most species particularly prone to warping and some checking; end-splitting is common. Kiln schedule T2-D4 is suggested for 4/4 stock and T2-D3 for 8/4. Shrinkage green to ovendry: radial 3.9%; tangential 5.7%.

Working Properties: Most species are reported to be fairly easy to saw and work; sawn surfaces are often woolly; dresses rather smoothly.

Durability: Rated as nondurable in ground contact and is vulnerable to termite attack as well as marine borers.

Preservation: Sapwood is reported to treat well; heartwood is fairly resistant, absorbing only 4 pcf using an open tank system.

Uses: Flooring, furniture components, light construction, boatbuilding, cabinetwork.

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CANANGIUM ODORATUM

CANANGA

Family: Annonaceae

Other Common Names: Fereng (Thailand), Ilang-Ilang (Philippines).

Distribution: Lower Burma, Malayan Peninsula, Philippines, Borneo, West Irian, and Australia. Widely cultivated for its flowers.

THE TREE May reach a height of 100 ft with diameters up to 30 in.; boles straight, cylindrical, and slightly buttressed.

THE WOOD General Characteristics: Wood pinkish-buff, yellowish to light gray; no differentiation between sapwood and heartwood. Texture coarse; grain straight; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.30; air-dry density 23 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	4,650	860	2,000
12%	6,630	1,060	3,380

Janka side hardness 310 lb for green material and 330 lb for dry. Forest Products Laboratory toughness 130 in.-lb for green material and 110 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Easy to season with little or no degrade. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.3%; tangential 8.0%.

Working Properties: Reported to be easy to work and finishes smoothly.

Durability: Very perishable and vulnerable to termite attack.

Preservation: No information available but related species are reported to be easily treated.

Uses: Turnery, boxes and crates, clogs-wooden shoes, fishnet floats. The tree is primarily favored for its flowers which yield an aromatic oil.

ADDITIONAL READING

1. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. *The Lumberman* 12(5):66+A-H.
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CANARIUM SPP.

KEDONDONG

Family: Burseraceae

Other Common Names: Dhup, White Dhup (India), Kedondong (Malaya), Merdongdong (Indonesia), Pagsahingin (Philippines), Kaunicina-Kaunigai (Fiji Islands).

Distribution: Throughout southeastern Asia and reaching northward to Taiwan.

THE TREE Commonly 80 to 100 ft in height with trunk diameters of 2 to 3 ft. Varies with species and may reach a height of 180 ft with a diameter of 5 ft. Boles with small to prominent buttresses.

THE WOOD General Characteristics: Heartwood usually pink or light brown, sometimes with yellow streaks, or reddish-brown; sapwood lighter and often not clearly demarcated. Texture fine to moderately coarse; grain rather straight to shallowly interlocked; lustrous; without distinctive odor or taste. Silica content up to 1.68% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species, mostly 0.35 to 0.52; air-dry density 26 to 40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	8,610	--	4,280

Forest Products Laboratory toughness 140 in.-lb for green material (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Generally reported to season well with little degrade. Kiln schedule T10-D4S is suggested for 4/4 stock of low density C. euphyllum. Shrinkage green to ovendry for C. asperum: radial 5.1%; tangential 6.6%.

Working Properties: Generally easy to work but varies with species because of density range and presence or absence of silica.

Durability: Heartwood perishable and is readily attacked by termites. Sapwood is very susceptible to powder-post beetle infestation.

Preservation: Sapwood is permeable, but heartwood is highly resistant to preservative treatment.

Uses: Veneer and plywood, light construction (under cover), furniture components, joinery, boxes, and crates.

ADDITIONAL READING

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2. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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CASTANOPSIS spp.

BERANGAN

Family: Fagaceae

Other Common Names: Philippine chestnut (Philippines), Indian chestnut (India), Thite (Burma).

Distribution: Widely distributed from India into Upper Burma, Malaysia, and the Philippines.

THE TREE Varies with species, often of poor form and with diameters of about 2^{1/4} in.; sometimes with diameters up to 45 in. and fairly straight boles 40 ft in length. Trees 100 ft in height are reported from the Philippines.

THE WOOD General Characteristics: Heartwood light yellowish-brown, grayish-brown, or dark brown, varying with species; sapwood yellowish, light brown, sometimes sharply demarcated. Texture mostly rather coarse; grain fairly straight to interlocked; may be lustrous when first cut; without distinctive odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species but mostly 0.50; air-dry density 42 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
12% (3)*	10,570	1,290	5,755

*See "Additional Reading" for reference.

Drying and Shrinkage: Generally reported to season well, timbers tend to end split if the pith is boxed. No data available on kiln schedules or shrinkage values.

Working Properties: Mostly reported as easy to work and saw; takes a good finish; easy to split.

Durability: Susceptible to attack by decay fungi and termites. Sapwood vulnerable to powder-post beetles.

Preservation: Sapwood penetration is reported to be good, but heartwood penetration is slight and streaky. Absorption of preservative oils using pressure-vacuum systems is about 5.5pcf.

Uses: General construction work under cover, furniture components, some species are used for shingles.

ADDITIONAL READING

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2. Desch, H. E.
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1932. Commercial timbers of India. Gov. of India. Central Publ. Br., Calcutta.

CASUARINA SPP.

CASUARINA

Family: Casuarinaceae

Other Common Names: She-Oak (Australia), Aru (Sabah), Ru (Malaya), Surra, Serva (India), Agoho (Philippines), Velau (Fiji Islands), Tjemara (Indonesia), Bois de fer de rivière (New Caledonia).

Distribution: Malay Peninsula, Burma, Australia, Philippines, and islands of the Pacific. Widely cultivated throughout the tropics. *C. equisetifolia* particularly favored along seashores.

THE TREE A rapidly growing tree that may reach a height of 120 to 150 ft with trunk diameters up to 24 in. Bole is often fluted, straight, and cylindrical.

THE WOOD **General Characteristics:** Heartwood light red to reddish-brown, becoming darker in older trees; sapwood buff-colored, usually distinct from heartwood. Texture fine, grain straight to interlocked; luster is low; without distinctive odor or taste. Species with wide rays have an attractive figure when quartered.

Weight: Basic specific gravity (ovendry weight/green volume) 0.83; air-dry density 64 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; the second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	14,300	1,890	6,600
12%	25,000	3,310	11,000
12% (<u>1</u>)	21,400	1,830	12,100

Janka side hardness 1,980 lb for green material and 3,200 lb for dry. Amsler toughness 182 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood dries at a moderate rate but usually with considerable warp and checking. Kiln schedule T2-C2 may be suitable for 4/4 stock. Shrinkage green to ovendry: radial 6.4%; tangential 11.7%; volumetric 17.6%.

Working Properties: Saws with difficulty and also difficult to work with hand and machine tools because of the high density, finishes smoothly.

Durability: Heartwood is generally reported as nondurable. In Puerto Rico the wood is rated as susceptible to dry-wood termites; but in the Philippines, it is rated as resistant.

Preservation: Sapwood is readily treated; heartwood absorption is irregular and only 5pcf when treated by a full-cell schedule.

Uses: Construction under cover, tool handles, posts and poles (treated), charcoal, tests in India indicate the wood is suitable for chemical and semichemical pulps.

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3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India. Central Publ. Br., Calcutta.
4. Sallenave, P.
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CEDRELA SPP.
(MAINLY C. TOONA)

TOON
AUSTRALIAN RED-CEDAR

Family: Meliaceae

Other Common Names: Toon (India), Thitkado (Burma), Youhom (Thailand), Soeren (Indonesia), Epi, Kapere (Papua-New Guinea).

Distribution: India and Burma as well as scattered in evergreen and moist mixed deciduous forests throughout Southeast Asia including Australia.

THE TREE May attain a height of 120 ft with a clear bole to 80 ft; trunk diameters up to 60 in., sometimes buttressed and fluted. Size and other characteristics vary with species.

THE WOOD General Characteristics: Heartwood light brick-red when first exposed aging to a rich reddish-brown; sapwood pinkish, grayish-white, or yellow-brown, rather sharply defined. Texture rather coarse and uneven; lustrous; grain generally straight to somewhat interlocked; fragrant cedar odor, pronounced when fresh, characteristic acrid taste.

Weight: Basic specific gravity (ovendry weight/green volume) averaging about 0.42; air-dry density 32pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	8,290	1,250	4,290
15%	11,895	1,550	6,485
Green (4)	5,700	1,010	2,790
12%	10,600	1,300	3,480

Janka side hardness ranges from 550 lb to 1,035 lb for dry material. Forest Products Laboratory toughness for green plantation-grown wood 165 in.-lb (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Somewhat refractory in drying characteristics, prone to warp and collapse. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to oven dry: radial 3.8%; tangential 6.3%; volumetric 10.8%.

Working Properties: The timber works well though there is some gumming of cutters, dresses smoothly; easy to nail, screw, and glue.

Durability: Heartwood is moderately durable but vulnerable to termite and borer attack.

Preservation: Reported to be treatable without a great deal of difficulty.

Uses: Joinery, furniture and cabinetwork, decorative veneers, racing boats, musical instruments, and patternmaking.

ADDITIONAL READING

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2. Krym, J. M.
1954. Information Leaflet Foreign Woods. Toon, Burma Cedar, Moulmein Cedar, Thitkado, Cedrela toona Roxb.; Cedrela serrata Royle; and Australian Red Cedar, Cedrela toona Roxb. var. Australis C.DC., Family Meliaceae. Rep. No. 1970, U.S. For. Prod. Lab., Madison, Wis.
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CHLOROXYLON SWIETENIA

EAST INDIAN SATINWOOD

Family: Rutaceae

Other Common Names: Satinwood, Billu, Mashwal, Mududad (India), Ceylon Satinwood (Ceylon).

Distribution: Central and southern India and Ceylon.

THE TREE A small to moderate-sized tree about 45 to 50 ft in height with a short clear bole of 10 ft; trunk diameter generally about 1 ft; the tree reaches its maximum size in Ceylon.

THE WOOD General Characteristics: Heartwood light yellow or golden-yellow; not distinctly demarcated from the sapwood. Texture fine and even; highly lustrous; grain narrowly interlocked, often with attractive mottle figure; fragrant but without characteristic taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.80; air-dry density 61 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	12,615	1,650	6,520
15%	16,500	2,020	10,030

Janka side hardness 1,840 lb for green material and 2,600 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: There is a tendency to warp and check in drying; seasoning of girdled trees is practiced. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 5.5%; tangential 7.1%.

Working Properties: Difficult to work with hand and machine tools, torn grain common when planing quartersawn surfaces; finishes cleanly; turns very well; takes a fine polish.

Durability: The heartwood is rated as extremely durable; sapwood vulnerable to attack by borers and termites.

Preservation: No data available.

Uses: Decorative veneers, furniture and cabinetwork, turnery, interior joinery, specialty items.

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2. Kukachka, B. F.
1970. Properties of imported tropical woods. USDA
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CHUKRASIA TABULARIS

CHICKRASSY

Family: Meliaceae

Other Common Names: Boga porna, Lal devderi, Aglay (India),
Yinma (Burma), Repoh (Malaya).

Distribution: India, Burma, Indo-China, and southwards to the
Malay Peninsula and Borneo.

THE TREE Up to 80 ft high with a straight cylindrical bole up to 30 ft
in length; trunk diameters are about 2 ft.

THE WOOD General Characteristics: Heartwood yellowish-red to red, aging
to a yellowish- or reddish-brown; sapwood yellowish or
light buff, grading into the heartwood. Lustrous with a
satiny sheen; texture moderately fine; grain irregularly
interlocked, wavy, figured; fragrant odor when fresh but
without characteristic odor or taste when dry.

Weight: Basic specific gravity (ovendry weight/green volume)
0.57; air-dry density 42pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 13%	8,380 11,940	1,190 1,570	4,040 6,870

Janka side hardness 1,060 lb for green material
and 1,310 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber seasons well even in thick sections but does tend to develop very fine surface checks. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 3.9%; tangential 6.0%; volumetric 10.9%. Reported to have a small movement.

Working Properties: The wood saws and machines easily and works well with hand tools; finishes smoothly and polishes well.

Durability: Rated as nondurable and reports on resistance to termite attack varies from moderately resistant to liable to attack.

Preservation: Extremely resistant to preservative treatment.

Uses: Furniture, decorative veneers, paneling, carving, turnery, cooperage.

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1972. Handbook of hardwoods. H. M. Stationery Office.
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2. Limaye, V. D.
1933. The physical and mechanical properties of woods
grown in India. Third Interim Report on Project 1.
Indian Forest Records 18(10):1-70.
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CINNAMOMUM SPP.

CINNAMON WOOD
CAMPHOR WOOD

Family: Lauraceae

Other Common Names: Dalchini, Ohez, Gondhori (India), Karawé Hmanthein (Burma), Kayu (Sabah), Kaliñgag (Philippines), Kusunoki (Japan).

Distribution: The various species are widely distributed in Southeast Asia, Southern China, Formosa, Japan, and southwards to Australia. Widely planted in tropical and subtropical parts of the world.

THE TREE Generally 60 to 100 ft in height with straight cylindrical boles 40 ft in length. Trunk diameters may range from 2 to 4 ft.

THE WOOD **General Characteristics:** Heartwood light yellowish, olive, reddish, brownish-gray to red, reddish-brown, orange-brown, or light brown, varying with species; not sharply demarcated from sapwood in some species. Sometimes figured with dark streaks; grain straight, interlocked, or wavy; texture medium coarse to fine; more or less lustrous; often fragrant with odors of camphor, anise oil, or other scents, without distinctive taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.35 to 0.50; air-dry density 26 to 39 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	10,700	--	5,660

Amsler toughness 120 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Generally reported to air season with little or no degrade, some species have a tendency to warp. A kiln schedule similar to T10-D2 has been suggested. Shrinkage green to ovendry: volumetric 7.4%. Reported to be moderately stable in use.

Working Properties: Easy to saw and works well with both hand and machine tools, finishes smoothly.

Durability: Variable with species; some reported to be durable in ground contact and largely immune to insect attack.

Preservation: No information available.

Uses: Cabinetwork, trunks, chests and caskets, furniture, wardrobes. Trees in this group are cultivated for cinnamon spice, natural camphor, and other aromatic oils.

ADDITIONAL READING

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to Wood Ind., Tokyo 11(6).
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Central Publ. Br., Calcutta.
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For. Trop. No. 8.

CORDIA SPP.

CORDIA

Family: Boraginaceae

Other Common Names: Bohari, Shelu, Kum paiman, Dhaivan (India), Thanat, Kalamet (Burma), Anonang, Balu (Philippines).

Distribution: India, Burma, Malay Peninsula, Philippines, and extends to North Borneo.

THE TREE Usually a small tree up to 50 ft in height, with a short irregular bole; about 2 ft in diameter.

THE WOOD **General Characteristics:** Heartwood variable from clear yellow or yellowish- or olive-gray to yellowish-brown, purple-brown, or dark brown, often with light to dark streaks; not sharply demarcated from the sapwood. Grain straight to shallowly interlocked, or wavy; texture moderately fine to somewhat coarse; dull to lustrous; oily feel; some species with fragrant odor, pronounced when fresh, others without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.40 to 0.65; air-dry density 30 to 50pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: All species reported to be easy to season.

No data available on kiln schedules. Shrinkage green to ovendry: radial 2.5%; tangential 6.2%.

Working Properties: Easy to saw and works well with both hand and machine tools.

Durability: Varies with species from durable to vulnerable to attack by decay fungi.

Preservation: No data available.

Uses: Furniture, cabinetmaking, novelty items, tool handles, musical instruments, carvings, turnery.

ADDITIONAL READING

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COTYLELOBIUM SPP.
and VATICA SPP.

RESAK

Family: Dipterocarpaceae

Other Common Names: Láu táo (Cambodia), Chan thip (Thailand), Narig (Philippines), Mascal wood (India), Taungsagaing (Burma).

Distribution: Widespread in Southeast Asia from India and Ceylon to New Guinea.

THE TREE Varies with species but may reach a height of 100 ft; trunk diameters usually about 2 ft, with or without buttresses.

THE WOOD General Characteristics: Heartwood yellowish when fresh, turning light to deep red-brown on exposure; sapwood lighter than heartwood, generally not sharply defined. Texture rather fine and even; grain straight or shallowly interlocked; not lustrous; without distinctive taste or odor when dry. Silica present in Cotylelobium.

Weight: Basic specific gravity (ovendry weight/green volume) varies considerably with species from 0.52 to 0.85; air-dry density 40 to 65 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard, second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,900	1,900	5,560
12%	19,600	2,540	9,000
12% (4)	17,000	--	7,500

Janka side hardness 1,120 lb for green material and 1,550 lb for dry. Forest Products Laboratory toughness for green material 270 in.-lb and 367 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to air season slowly but with some warp and checking. Philippine species reported to dry well with little degrade. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.0%; tangential 9.3%.

Working Properties: Reported to be difficult to saw because of clogging due to gummy resins; otherwise machines well to a smooth finish; turns well. Due to silica in Cotylelobium there is dulling of cutters.

Durability: Heartwood, particularly that of the denser species, rated as durable to very durable; termite resistance is similarly rated.

Preservation: Heartwood rated as difficult to treat.

Uses: Turnery, heavy construction, mining timbers, railroad crossties, boat construction, also suggested for flooring, interior joinery, and cabinetwork.

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CRATOXYLON ARBORESCENS

GERONGGANG

Family: Guttiferae

Other Common Names: Serungan (Sabah, Northern Sarawak, Brunei).

Distribution: Locally common in Malaysia and Indonesia, mainly in coastal dipterocarp swamp forests.

THE TREE

Rarely exceeding 60 ft in height; diameters may reach 3 ft; without buttresses.

THE WOOD

General Characteristics: Heartwood varies from light brick-red to dark pink, darkening upon exposure; sapwood yellow, sometimes with a pink or orange tinge, usually clearly demarcated. Texture uniform and rather coarse; grain typically straight, sometimes interlocked; lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40; air-dry density 30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (1)*	5,750	1,160	2,660

Janka side hardness 420 lb for green material.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber seasons rapidly without difficulty. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to air dry: radial 2.6%; tangential 4.7%.

Working Properties: The timber saws without difficulty and dresses to a smooth surface but cutters are reported to dull rapidly.

Durability: Rapidly attacked by decay fungi if in ground contact and vulnerable to termites. Not resistant to marine borers.

Preservation: Easily treated using the open tank system; absorptions of over 20 pcf are reported.

Uses: Furniture, joinery, veneer and plywood, light construction, particleboard, fiberboard. Reported to make good roofing shingles if impregnated with preservatives.

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1950. Malayan timbers. Geronggang (Cratoxylon spp.). The Malayan Forester 13(2):86-88.

CRYPTOCARYA spp.

ROSE-MAPLE

Family: Lauraceae

Other Common Names: Rose-Maple, White Laurel (Australia), Tawenna (Ceylon), Dugkatan, Lamot (Philippines), Moustiquaire (New Caledonia), Medang (Malaya).

Distribution: Ranging from southern India and Ceylon into Malaysia and the Philippines and southward to Australia.

THE TREE Varies with species but may reach a height of 120 ft and trunk diameters of 30 to 45 in. Some species are small trees with diameters of only 12 in.

THE WOOD General Characteristics: Heartwood pinkish-brown, grayish-brown, reddish-brown, or chocolate-brown; sapwood lighter in color but not distinct. Grain usually straight; texture rather fine to medium; luster low; sometimes with an aromatic odor when freshly cut but without distinctive odor or taste when dry. Silica content up to 0.82% reported for some species.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.45 to 0.73; air-dry density 35 to 55 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	19,600	--	6,090
12%	23,400	2,740	11,600
12% (<u>1</u>)	19,300	2,490	9,680
12% (<u>2</u>)	14,500	1,510	6,400

Janka side hardness 1,515 lb to 2,095 lb for dry material. Forest Products Laboratory toughness 137 to 154 in.-lb for dry material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Some species are reported to be easy to season; others have a tendency to warp and split. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.2%; tangential 7.6%; volumetric 12.2%.

Working Properties: Generally reported to be not difficult to work with hand and machine tools.

Durability: Variable with species; C. erythroxylon of Australia is not resistant to decay, while C. bicolor in the Philippines is reported to be durable. Sapwood prone to powder-post beetle attack.

Preservation: No data available.

Uses: Cabinetwork, flooring, joinery, decorative veneers, paneling, construction (C. membranacea).

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1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Francaise. Publ. Centre Tech. For. Trop. No. 8.
3. U.K.: Wood.
1960. Specimen Woods No. 296. Rose-Maple (Cryptocarya erythroxylon). Suppl. to Wood 25(8).

CYNOMETRA spp.

KEKATONG

Family: Leguminosae

Other Common Names: Myinga (Burma), Katong (Sabah), Mang-kha (Thailand), Oringen (Philippines), Kekatong, Belangkan (Malaya), Moivi (Fiji Islands).

Distribution: Through the Indo-Malayan region to the Philippines, Australia, and the Pacific Islands.

THE TREE Mostly a small tree with a height up to 80 ft; trunk diameters 18 to 24 in., reaching 30 in.; often of rather poor form.

THE WOOD General Characteristics: Heartwood claret-red, pinkish-brown, to red-brown, attractively streaked, and a brown-black core in Malayan material; sapwood lighter in color but not clearly defined. Grain straight or somewhat irregular; texture fine to medium; luster variable; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.80; air-dry density 60pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 11%	13,585 18,275	1,880 2,330	6,635 9,585
17% (<u>2</u>)	19,610	2,730	9,820

Janka side hardness 1,950 lb for green material and 2,340 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to air season satisfactorily with some checking and warp. Serious end-splits if left in log form are reported. Kiln schedule T6-D4 may be suitable for 4/4 stock. Shrinkage green to air dry: radial 3%; tangential 8%.

Working Properties: Rather difficult to saw but cuts easily with hardened teeth, dresses smoothly, and finishes well.

Durability: Heartwood is vulnerable to attack by decay fungi and sapwood prone to powder-post beetles.

Preservation: Reported to absorb about 7 pcf of preservative oils if pressure treated; rated as reasonably easy to impregnate.

Uses: Interior construction work, railroad crossties (treated).

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Records 15. 2 vol.
3. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim report on Project 1. Indian For. Rec. 18(10):1-70.
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1932. Commercial timbers of India. Gov. of India, Central Publ. Br., Calcutta.

DACRYDIUM SPP.

RIMU

Family: Podocarpaceae

Other Common Names: Huon Pine (Australia), Sempilor (Sabah), Melor (Sarawak), Ru Bukit, Ekor Kuda (Malaya).

Distribution: New Zealand, Australia, New Caledonia, Malay Archipelago, and Borneo.

THE TREE Usually 60 to 100 ft in height, with a long, straight, clear bole with little taper; diameters mostly 2 to 4 ft. Heights of 120 ft and trunk diameters of 8 ft are reported.

THE WOOD **General Characteristics:** Heartwood pale yellow, yellowish-brown or reddish-brown, varying with species, irregular dark streaks in D. cupressinum; sapwood paler, not always clearly differentiated. Texture fine and even; grain straight; sometimes with resinous odor.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.40 to 0.52; air-dry density 30 to 40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 12%	7,440 11,100	1,220 1,310	3,290 5,430
Green (<u>2</u>) 12%	6,440 8,500	790 1,070	3,050 5,830

Janka side hardness 625 lb for green material and 785 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to dry readily without serious degrade; green moisture contents, though, are very high. Kiln schedule T13-C4S is suggested for 4/4 stock and T11-D3S for 8/4. Shrinkage green to 12% moisture content: radial 3.0%; tangential 4.2%; volumetric 6.2%.

Working Properties: Easy to work with hand and machine tools; turns well, and takes a good finish. Dry wood tends to split on nailing so green wood is used in framing or is prebored.

Durability: Not durable in ground contact.

Preservation: Heartwood is resistant to preservative treatments but sapwood is responsive to pressure and nonpressure systems.

Uses: Light construction, joinery, furniture components, flooring, boxes and crates, plywood.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Entrican, A. R., W. C. Ward, and J. S. Reid.
1951. The physical and mechanical properties of the principal indigenous woods of New Zealand. New Zealand Forest Serv., Wellington.
3. Ward, W. C., revised by J. S. Reid.
1949. The properties and uses of Rimu (Dacrydium cupressinum). Inform. Ser. N.Z. For. Serv. No. 2.

DACTYLOCLADUS STENOSTACHYS

JONGKONG

Family: Melastomataceae

Other Common Names: Merebong (Sarawak), Sampinur (Indonesia), Medang Tabak (Sabah).

Distribution: Indonesia and Sarawak-Sabah; found in peat swamp forests.

THE TREE May reach a height of 80 ft; with trunk diameters of 20 to 24 in., occasionally reaching 48 in.

THE WOOD General Characteristics: Heartwood yellowish with a pink tinge when freshly cut turning to a red-brown, usually with white flecks, upon drying and exposure; sapwood not differentiated by color. Texture rather fine and even; grain straight or slightly interlocked; without distinctive odor or taste. Included phloem in radial strands present.

Weight: Basic specific gravity (ovendry weight/green volume) 0.42; air-dry density 34 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	6,510	1,345	3,470
17%	9,150	1,560	4,730
12% (2)	13,250	--	7,550

Janka side hardness 720 lb at 12% moisture content.
Forest Products Laboratory toughness 81 in.-lb
for dry material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to be easy to season with little or no degrade, though slight collapse may take place in kiln drying. Kiln schedule data not available. Shrinkage green to 12%; radial 2.1%; tangential 4.1%.

Working Properties: Very easy to work and dresses to a smooth finish; cuts cleanly across the grain.

Durability: Not resistant to attack by decay fungi and vulnerable to termites and other insects.

Preservation: Though no data are available, it is suggested that the wood is treatable.

Uses: Form work, general construction, furniture components, plywood, interior millwork, used for shingles when treated.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Kloot, N. H., and E. Bolza.
1961. Properties of timbers imported into Australia.
CSIRO Div. For. Prod. Tech. Pap. No. 12.
3. Sarawak Forestry Department.
1961. Common Sarawak timbers. Borneo Literature Bureau,
Kuching.

DALBERGIA LATIFOLIA

INDIAN ROSEWOOD

Family: Leguminosae

Other Common Names: Shisham (India).

Distribution: Throughout the Indian peninsula scattered in the dry deciduous forests, but nowhere common; attains its best growth in the Bombay region.

THE TREE On favorable sites, trees reach a height of 100 ft, with clear, cylindrical boles 35 to 50 ft in length; diameters may reach 5 ft, more often 2-1/2 ft or less.

THE WOOD General Characteristics; Heartwood varying in color from golden-brown to dark purple-brown with darker streaks giving an attractive figure; sapwood yellowish often with a purplish tinge, sharply demarcated. Grain narrowly interlocked; texture moderately coarse; luster low; fragrant when freshly cut but without distinctive odor or taste when seasoned.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 53 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	9,190	1,190	4,530
12%	16,920	1,780	9,220
Green (<u>1</u>)	9,700	1,110	4,700
12%	17,500	1,660	9,450

Janka side hardness 1,560 lb for green material and 3,170 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: The timber seasons well with no appreciable degrade and is reported to dry in log form defect-free. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 2.7%; tangential 5.8%; volumetric 8.5%. Movement in service is small.

Working Properties: Moderately difficult to work with hand and machine tools because of the high density; chalky deposits, if present, will dull cutters; glues well and takes an excellent finish; can be peeled and sliced for veneer.

Durability: Heartwood is rated as highly resistant to attack by decay fungi and termites. Sapwood vulnerable to powder-post beetles.

Preservation: No information available.

Uses: Fine furniture and cabinetwork, musical instruments, turnery, decorative veneers, specialty items.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Limaye, V. D.
1933. The physical and mechanical properties of woods
grown in India. Third interim report on Project 1.
Indian For. Rec. 18(10):1-70.
3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India.
Central Publ. Br., Calcutta.

DIALIUM spp.

KERANJI

Family: Leguminosae

Other Common Names: Khleng (Thailand), Xoay, Kralanh (Cambodia), Kerandji (Indonesia).

Distribution: Malay Peninsula and extending into Indonesia as well as Sabah and Sarawak; found on flat and hilly lands but not in swamps.

THE TREE Typically a rather slender tree with diameters up to 30 in. above buttresses; clear boles to 55 ft but frequently fluted or twisted.

THE WOOD General Characteristics: Heartwood generally golden-brown or red-brown when freshly cut but darkening on exposure, some species becoming almost black; sapwood white to yellowish-white, distinct. Texture moderately fine to somewhat coarse; grain interlocked to wavy; moderately to highly lustrous; without distinctive odor or taste; ripple marks prominent.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species, about 0.80; air-dry density 60 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second and third sets on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	27,200	--	10,800
Green (2)	22,790	2,790	12,860
Green (2)	18,700	3,060	9,970

Janka side hardness 2,545 to 3,745 lb for green material. Amsler toughness 665 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Prone to checking during seasoning.

Kiln schedule T6-D2 is suggested for 4/4 stock. Shrinkage green to 15% moisture content: radial 3.7%; tangential 6.6%.

Working Properties: Difficult to saw and machine because of the high density, rapid dulling of cutters, dresses smoothly.

Durability: Reported to be only moderately durable in ground contact. Sapwood vulnerable to powder-post beetle attack.

Preservation: Timber is resistant to impregnation, absorbing only 2.4 pcf of creosote-oil mixture using an open tank system.

Uses: Carpenter tools, tool handles, industrial flooring, machinery parts, heavy construction.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15. 2 vol.
3. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

DILLENSIA SPP.

SIMPOH

Family: Dilleniaceae

Other Common Names: Katmon (Philippines), San, San-na (Thailand), Thabyu (Burma), Simpur (Indonesia), Poplea (Cambodia), Dillenia (India).

Distribution: Indo-Malaysia.

THE TREE Often a medium-sized tree but some species may reach a height of 120 ft with a clear bole 75 ft long; diameters may reach 3 ft; often buttressed and stilt-rooted.

THE WOOD **General Characteristics:** Heartwood red-brown, sometimes with a purplish tinge and occasional white lines due to deposits in the vessels; sapwood lighter in color and poorly defined. Grain straight to irregular; texture rather coarse but even; somewhat lustrous; without distinctive odor or taste; figured on quartered faces.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.46 to 0.72; air-dry density 35 to 55 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)* 11%	8,570 13,595	1,225 1,710	4,155 7,010
Green (<u>2</u>) 12%	5,200 --	-- --	3,480 5,950
12% (<u>4</u>)	15,700	--	8,500

Janka side hardness about 1,000 to 1,500 lb for dry material. Amsler toughness 171 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally prone to warp and end checking during seasoning; much of the degrade can be avoided by quartersawing. Kiln schedule T3-C2 is suggested for 4/4 stock. Shrinkage green to air dry: radial 2.2%; tangential 3.9%.

Working Properties: Saws and works well, dresses smoothly. Very fine sawdust tends to clog the saw.

Durability: Heartwood not durable and sapwood liable to powder-post beetle attack.

Preservation: Heartwood absorptions of 6 to 10 pcf of preservative oils are reported for open tank and pressure process.

Uses: Plywood, interior joinery, furniture and cabinetwork, railroad crossties if treated.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
3. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1. Indian For. Rec. 18(10):1-70.
4. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

DIOSPYROS SPP.

EAST INDIAN EBONY

Family: Ebenaceae

Other Common Names: Kayu Malam (Sabah), Kaya Arang (Malaya), Trayung (Cambodia), Marblewood (Andaman Islands), Kamagong (Philippines).

Distribution: Throughout the Indo-Malayan region. D. ebenum is the original ebony of commerce, and it reached its best development in Ceylon.

THE TREE Varies with species, often only 50 ft in height with boles 15 to 20 ft long; trunk diameters 1 to 2 ft.

THE WOOD **General Characteristics:** Heartwood varies with species, uniformly black, with light-colored streaks, pale to medium brown zones, or with marked contrast between almost white and black wood; sapwood varies from white or yellow to brown or reddish. Grain straight, sometimes irregular; texture fine and even; lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species from 0.60 to 0.80; air-dry density 45 to 60 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second and third sets on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 12%	7,780 11,125	1,095 1,435	3,985 5,960
Green (<u>4</u>) 12%	10,140 18,790	1,490 2,040	4,650 9,510
12% (<u>3</u>)	18,500	--	8,900

Janka side hardness about 1,630 lb for dry material. Amsler toughness 320 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Difficult to season, black portions particularly prone to checking. Standing trees are often girdled and allowed to season in place prior to felling. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry for D. philippensis: radial 5.4%; tangential 8.8%.

Working Properties: Very difficult to work with hand and machine tools because of high density but takes a smooth finish and a fine polish; turns well.

Durability: The black heartwood is very durable but reported to be only moderately resistant to termites in Ceylon and India.

Preservation: Sapwood of D. discocalyx is easily treated with preservative oils, absorbing 20pcf using a full-cell treatment.

Uses: Turnery, piano keys, carving, brush backs, inlaying, parts of stringed instruments, marquetry.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Limaye, V. D.
1933. The physical and mechanical properties of woods
grown in India. Third interim report on Proj. 1.
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tropicaux de l'union Française. Publ. Centre Tech. For.
Trop. No. 8.
4. U.K.: F.P.R.L.
1972. Report on a consignment of Kayu Malam (Diospyros discocalyx) from Sabah. PRL consignment No. 1481.
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No. 17.

DIPTEROCARPUS spp.

KERUING
APITONG

Family: Dipterocarpaceae

Other Common Names: Eng, In (Burma), Yang, Heng (Thailand), Lagan, Keroeing (Indonesia), Dau (Vietnam, Cambodia), Gurjun (India).

Distribution: Widely scattered throughout the Indo-Malayan region. More than 70 species make up this group, and they are marketed collectively. Timbers from Malaysia contain a large number of species and are most variable in properties.

THE TREE Varies with species but commonly reach heights of 100 to 200 ft with clear, cylindrical boles 70 ft long; trunk diameters 3 to 6 ft, commonly with a small buttressed base.

THE WOOD **General Characteristics:** Heartwood varies from light to dark reddish brown or brown to dark brown, sometimes with a purple tint; usually well defined from the gray or buff sapwood. Texture moderately coarse; grain straight or shallowly interlocked; luster low; strong resinous odor when freshly cut, without taste. Resin exudation may be troublesome. Silica content variable, generally less than 0.5%.

Weight: Basic specific gravity (ovendry weight/green volume) mostly 0.57 to 0.65; air-dry density 45 to 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
		Psi	1,000 psi
Green (<u>3</u>)* 12%	8,500 16,700	1,750 2,510	4,050 8,600
Green (<u>1</u>) 12%	11,900 19,900	1,710 2,080	5,690 10,500

Janka side hardness about 1,520 lb for dry material. Forest Products Laboratory toughness 240 in.-lb for green material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly often with considerable degrade due to checking and warp and sometimes collapse. Resin exudation is common, particularly at high temperatures. Kiln schedule T3-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to air dry: radial 2.5-5.5%; tangential 7.5-11.5%. Movement in service medium to large.

Working Properties: Generally saws and machines well, particularly when green. Blunting of cutters moderate to severe due to silica content. Sometimes difficult to glue. Resin adhering to machinery and tools may be troublesome. Resin may also interfere with finishes.

Durability: Durability varies with species, generally classified as moderately durable, but heartwood is susceptible to termite attack. Though silica content may be high, resistance to marine borers is erratic.

Preservation: Sapwood and heartwood are both rated as moderately resistant to preservative treatments using either open tank or pressure systems.

Uses: General construction work, framework for boats, flooring, pallets, chemical processing equipment, veneer and plywood, suggested for railroad crossties if treated.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Farmer, R. H. (ed.).
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Philippine woods. The Lumberman 12(5):66+A-H.
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1932. Commercial timbers of India. Gov. of India.
Central Publ. Br., Calcutta.

DRACONTOMELUM SPP.

PALDAO
SENGKUANG

Family: Anacardiaceae

Other Common Names: New Guinea Walnut (New Guinea, Australia), Lamio, Dao (Philippines), Damoni, Dorea, Loup (New Guinea and Papua), New Guineawood (USA).

Distribution: Widely distributed in Southeast Asia and the Southwest Pacific Islands.

THE TREE A large tree reaching a height of 120 ft with clear straight boles 65-80 ft in length above high buttresses that may reach 20 ft; trunk diameters 6-7 ft above the buttress.

THE WOOD General Characteristics: Heartwood varies from light brown, grayish, greenish-yellow to reddish-brown often with irregular dark brown to nearly black banding; sapwood wide, pinkish, or grayish. Grain straight to interlocked and irregular; texture moderately fine to coarse; lustrous; without distinctive odor or taste; with decorative figure if quarter cut.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.45-0.54; air-dry density 35-42 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	<u>Psi</u>	<u>1,000 psi</u>	<u>Psi</u>
Green (4)*	10,500	1,350	4,600
12%	14,600	1,820	7,200
Green (1)	8,540	1,400	4,300
12%	11,800	1,660	6,700

Janka side hardness 830-1,130 lb at 12% moisture content. Forest Products Laboratory toughness 334 in.-lb for green material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Tendency to warp and twist on drying (D. dao), but D. mangiferum is reported to be easy to season. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.9%; tangential 7.5%.

Working Properties: Easy to work, glues satisfactorily, and takes a good finish and polish, veneers well.

Durability: Heartwood is nondurable and is not resistant to termite attack.

Preservation: No information available.

Uses: Furniture and cabinetwork, paneling, decorative veneers (walnut-like in appearance), gunstocks, flooring, joinery.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
1966. The mechanical properties of 81 New Guinea timbers.
CSIRO. Div. For. Prod. Tec. Pap. No. 41.
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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
3. Farmer, R. H. (ed.).
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1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.

DRYOBALANOPS spp.

KAPUR

Family: Dipterocarpaceae

Other Common Names: Keladan, Kapur (Malaya), Kapoer (Indonesia), Borneo camphorwood (Great Britain).

Distribution: Malaya, Sumatra, and Borneo including Sabah and Sarawak; mostly on well-drained soils, often grows gregariously.

THE TREE Very large trees to a height of 200-250 ft with straight clear boles 90-100 ft in length above well-developed buttresses; trunk diameters often 3-5 ft and may reach 11 ft.

THE WOOD **General Characteristics:** Heartwood reddish-brown; clearly demarcated from the whitish to yellowish-brown sapwood, rather narrow. Texture moderately coarse; grain straight to shallowly interlocked; luster high; without distinctive taste but with a strong camphor-like smell when freshly cut which is lost after exposure; contains resin ducts that normally does not exude over wood surfaces. Silica content of 0.12-0.91 is reported.

Weight: Basic specific gravity (ovendry weight/green volume) usually 0.57-0.65; air-dry density 45-50 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	11,700	1,580	5,980
12%	16,900	1,930	9,630
Green (<u>1</u>)	12,150	2,305	6,740
15%	16,480	2,710	8,940

Janka side hardness 1,230 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rather slowly and with only slight cup and some shake. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4 (D. lanceolata). Shrinkage green to oven-dry: radial 4.6%; tangential 10.2%. Movement in service is rated as medium.

Working Properties: The wood works fairly well with hand and machine tools, blunting of cutters may be severe particularly when machining dry wood because of silica content. Slight gumming may take place during sawing. Nails and screws well. Wet wood will stain in presence of iron. Glue bonds reported not durable in exterior plywood bonded with phenolic adhesives.

Durability: Heartwood is rated resistant to **attack by decay** fungi but is reported to be vulnerable to termites; sapwood liable to powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood is rated permeable.

Uses: Heavy construction work, furniture components, flooring, cores and backs of plywood (glues well with urea formaldehyde), boat framing, joinery.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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DUABANGA spp.

MAGAS
LAMPATI

Family: Sonneratiaceae

Other Common Names: Loktob (Philippines), Myaukngoo (Burma), Berembang bukit (Malaya), Lamphu (Thailand).

Distribution: Indo-Malayan region extending into the Philippines, a lowland species found along streams and on abandoned farmlands.

THE TREE Stems are straight and clear to 30-35 ft; trunk diameters usually 2-3 ft but may reach 6 ft.

THE WOOD General Characteristics: Heartwood light reddish-brown, pale brown, or grayish and often with yellow to light nut-brown streaks; not distinct from sapwood. Texture coarse; grain straight to shallowly interlocked or wavy; rather lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.33; air-dry density 25pcf.

Mechanical Properties: (First set of data based on 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	5,230	755	2,470
12%	7,100	940	3,900
Green (<u>2</u>)	6,985	1,190	3,660
14%	9,115	1,270	4,660

Janka side hardness 310-615 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: The timber is easy to season. Kiln schedule T13-C4S is suggested for 4/4 stock and T11-D3S for 8/4 but T10-D5S should be used for 4/4 lumber to avoid darkening. Shrinkage green to 12% moisture content: radial 1.5%; tangential 3.0%. Movement in service is rated as small.

Working Properties: The wood works well with both hand and machine tools; though of low density, the timber is easy to turn. Easy to nail. Rotary peels well even when cut cold up to veneer thicknesses of 3.2 mm.

Durability: The wood is very susceptible to attack by decay fungi and termites.

Preservation: A full-cell treatment using creosote has resulted in absorptions of about 15 pcf, but the wood is rated as moderately resistant because of irregular penetration.

Uses: Utility plywood, core stock, furniture components, millwork, joinery.

ADDITIONAL READING

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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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4. U.K.: F.P.R.L.
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DURIO SPP.
and NEESIA SPP.

DURIAN

Family: Bombacaceae

Other Common Names: Punggai, Apa apa, Bengang (Malaya).

Distribution: Reported to have a wide distribution in Southeast Asia.

THE TREE Varies with species but mostly with heights of 70-135 ft, reaching 180 ft; trunk diameters usually 2-4 ft, sometimes buttressed.

THE WOOD General Characteristics: Heartwood pink-brown, red, or deep red-brown; sapwood white, pale yellow-brown or light reddish-yellow not always sharply defined. Texture coarse; grain straight to interlocked; somewhat lustrous; reported to have a fetid odor.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.40-0.66; air-dry density 30-50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)* 16%	7,990 10,690	1,530 1,700	3,980 5,670
Green (2) 17%	7,340 9,420	1,260 1,380	3,850 4,730

Janka side hardness 560-800 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries rapidly but thin boards may tend to cup. No data available on kiln schedules. Shrinkage green to ovendry for Durio: radial 4.3%; tangential 7.2%; volumetric 12.3%, somewhat less for Neesia.

Working Properties: The timbers saw easily and generally dress smoothly; nailing qualities are good.

Durability: The timbers are nondurable and not resistant to termite attack; sapwood prone to powder-post beetle attack.

Preservation: Reported to treat well by cold soaking using preservative oils and should respond to open tank and pressure systems.

Uses: Furniture components, veneer and plywood, light construction. Species of Durio favored for their edible fruits.

ADDITIONAL READING

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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers.
Malayan Forester 28(4):307-319.
3. Sarawak For. Dep.
1961. Common Sarawak timbers. Borneo Literature Bureau,
Kuching.

DYERA COSTULATA

JELUTONG

Family: Apocynaceae

Other Common Names: Jelutong bukit (Sarawak).

Distribution: Malaysia and Brunei.

THE TREE May reach a height of 200 ft, with straight and cylindrical boles free from buttresses to lengths of 90 ft; trunk diameters up to 8 ft.

THE WOOD General Characteristics: Heartwood creamy white to pale straw not differentiated from sapwood. Grain mostly straight; texture moderately fine and even; slightly lustrous; without taste but has a slight sour odor that is distinctive. Marked with latex traces or canals often in clusters 2 to 3 ft apart along the stem.

Weight: Basic specific gravity (ovendry weight/green volume) 0.36; air-dry density 28 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	5,570	1,155	3,050
16%	7,315	1,180	3,920

Janka side hardness 330 lb for green material and 390 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries easily with little or no degrade. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 2.3%; tangential 5.5%; volumetric 6.2%. Movement in service is rated small.

Working Properties: Works easily with hand and machine tools but may gum the cutters; excellent for carving; glues satisfactorily.

Durability: Nondurable, prone to sap stain, and is readily attacked by termites and powder-post beetles.

Preservation: Reported to absorb preservatives readily and is easily treated using the open tank system.

Uses: Patternmaking, drawing boards, carvings, wooden shoes, picture frames, pencil slats. The tree yields a latex used in the manufacture of chewing gum.

ADDITIONAL READING

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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
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3. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers.
Malayan Forester 28(4):307-319.

ENDIANDRA PALMERSTONII

**ORIENTALWOOD
QUEENSLAND-WALNUT**

Family: Lauraceae

Other Common Names: Walnut bean (Australia).

Distribution: Confined to Northern Queensland (Australia), chiefly in the coastal districts.

THE TREE A large tree 120-140 ft in height, boles above buttresses well formed and clear to 80 ft; trunk diameters up to 6 ft.

THE WOOD **General Characteristics:** Heartwood varies from light or pinkish-brown to dark brown, often with pinkish, grayish-green or blackish streaks, resembles European walnut; sapwood light brown, 3-4 in. in width. Grain generally interlocked and frequently wavy giving a broken stripe figure when quartered; texture medium; without distinctive odor or taste when dry; lustrous. Silica content of 0.19-1.08% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.55; air-dry density 42pcf.

Mechanical Properties: No data available.

Drying and Shrinkage: Dries rapidly with some tendency to warp and collapse. End coating is suggested to avoid splitting. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.5%; tangential 8.6%.

Working Properties: Works rather well provided cutting edges are kept sharp. Silica deposits cause rapid dulling of knives so carbide-tipped cutters should be used. Gluing is satisfactory.

Durability: Rated as nondurable.

Preservation: No information available.

Uses: Furniture, cabinetwork, decorative veneers, paneling, joinery and millwork, flooring.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Mell, C. D.
1929. The facts about Queensland (Oriental) walnut.
Veneers 23(4):27-

ENDOSPERMUM SPP.

GUBAS
KAUVULA

Family: Euphorbiaceae

Other Common Names: Sesendok, Sendok sendok (Malaya, Sabah), Terbulan, Ekor belangkas (Sarawak), Gubas (Philippines).

Distribution: Malaya, Philippines, New Guinea, Fiji and other western Pacific islands. Common in lowland forests, especially in secondary growth (Malaya).

THE TREE Trees are 80-100 ft in height; with trunk diameters to 3 ft, occasionally reaching 5 ft. Boles are clear but heavily buttressed.

THE WOOD **General Characteristics:** Heartwood light brown, straw, or pale cream in color; not differentiated from the sapwood. Texture rather coarse; grain straight to shallowly interlocked; somewhat lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.38; air-dry density 30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	--	--	3,350

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries rapidly with only slight warping and checking. If tension wood is not discarded, warp is severe. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage from green to 12% moisture content: radial 2.0%; tangential 3.6%.

Working Properties: The wood machines easily in both the green and dry condition though surfaces may be slightly woolly when sawn; can be peeled for veneer without prior heating.

Durability: The timber is nondurable and is particularly prone to stain and powder-post beetle attack.

Preservation: Easily treated using open tank or pressure systems.

Uses: Joinery, matches, patternmaking, boxes and crates, furniture components, plywood, light construction, carvings, wooden shoes.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Department of Forestry, Suva.
1967. Fiji timbers and their uses. The properties and potential uses of Kauvula (Endospermum macrophyllum). Dept. of For., Suva, Fiji.
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1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15.
2 vol.

EUCALYPTUS DEGLUPTA

DEGLUPTA

Family: Myrtaceae

Other Common Names: Bagras (Philippines), Mindanao gum (Australia), Komo, Kamarere (New Guinea).

Distribution: Native to the Philippines and other western Pacific islands. Favored as a plantation species throughout the world in lowland humid tropics.

THE TREE One of the largest and tallest trees in the Philippines, boles are straight and clear to 100 ft; with trunk diameters to 80 in.

THE WOOD General Characteristics: Heartwood varies from light red, light brown, to dark red-brown; sapwood whitish, not always distinctly marked off from the sapwood. Texture moderately coarse; grain decidedly interlocked, showing a typical ribbon grain when quartered; lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume): forest grown 0.45-0.65, young plantation material 0.35-0.40; air-dry density forest grown 35-50pcf; plantation 25-30 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	10,550	1,530	5,650

Janka side hardness for dry material 470 lb. Forest Products Laboratory toughness 87 in.-lb for dry material (2-cm standard).

*See "Additional Reading" for reference.

Drying and Shrinkage: Generally reported to be easy to dry with little degrade if plantation-grown, forest-grown wood reported to collapse and prone to honeycomb. Kiln schedule similar to T6-D2 used in Fiji for 4/4 plantation stock. Shrinkage green to ovendry: radial 3.9%; tangential 7.8%.

Working Properties: Both forest- and plantation-grown wood easy to saw and machine but does not dress smoothly on quartered faces; takes a good finish.

Durability: Heartwood not resistant to attack by decay fungi; sapwood susceptible to powder-post beetle attack.

Preservation: Sapwood easily treated using open tank or pressure systems.

Uses: Furniture components, general construction, millwork, posts and poles (treated), pulp and paper products.

ADDITIONAL READING

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3. Slooten, H. J. van der, and L. Llach C.
1969. Physical and mechanical properties of Eucalyptus deglupta Blume grown in Costa Rica. Turrialba 19(2): 284-290.

EUCALYPTUS DIVERSICOLOR

KARRI

Family: Myrtaceae

Other Common Names: None.

Distribution: Southwestern Australia.

THE TREE Reaches a height of 150-200 ft, with clear bole lengths of 80-100 ft; trunk diameters 6-10 ft.

THE WOOD General Characteristics: Heartwood reddish-brown; sapwood paler. Grain interlocked; producing a striped figure on quartered surfaces; texture moderately coarse; without distinctive odor or taste; may contain gum veins.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 57 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	10,600	2,070	5,250
12%	19,200	2,760	10,400

Janka side hardness 1,360 lb for green wood and 2,030 lb for dry. Forest Products Laboratory toughness 200 in.-lb for green wood and 208 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood has a pronounced tendency to check in drying and thin stock is prone to warp. Partial air drying prior to kiln drying is suggested. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 7.2%; tangential 10.7%. Movement in service is large.

Working Properties: Difficult to work with hand and machine tools, particularly quartered faces, finishes and polishes well, glues satisfactorily.

Durability: Heartwood is rated as durable though less so than Jarrah (*E. marginata*).

Preservation: Heartwood extremely resistant to preservation treatments.

Uses: Heavy construction but not for dock and harbor work, flooring, used locally for plywood.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot. 1963. The mechanical properties of 174 Australian timbers. CSIRO Div. For. Prod. Tec. Pap. No. 25.
2. Farmer, R. H. (ed.). 1972. Handbook of hardwoods. H. M. Stationery Office. London.

EUCALYPTUS GLOBULUS

BLUEGUM

Family: Myrtaceae

Other Common Names: None.

Distribution: Found mainly in Tasmania (Australia) but extensively cultivated in plantations in subtropical regions, has been favored in California and Hawaii.

THE TREE In its natural habitat reaches a height of 150 ft with a trunk diameter of 3-5 ft.

THE WOOD General Characteristics: Heartwood pale yellow-brown; sapwood grayish-white. Grain usually interlocked; texture moderately coarse; luster rather low; without distinctive odor or taste; frequently contains gum veins that may detract from the appearance.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.80 for forest-grown material and 0.67 for plantation-grown; air-dry density 61 and 51pcf respectively.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	12,200	2,160	6,180
12%	21,200	2,950	12,000
Green (<u>2</u>)	11,200	2,010	5,250
12%	16,600	2,370	9,940

Janka side hardness 1,540-2,580 lb for dry material.
Forest Products Laboratory toughness 209 in.-lb for green material and 234 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Somewhat difficult to season, prone to checking with some tendency to warp and collapse. Kiln schedule T3-C2 is suggested for 4/4 stock with a reconditioning treatment (steaming) at a moisture content of 20% to remove collapse. Shrinkage green to oven dry: radial 8%; tangential 12%. Movement in service is large.

Working Properties: Saws well, torn grain is common when dressing quartered faces. Rotary peels well if bolts are heated.

Durability: Heartwood moderately resistant to decay; sapwood vulnerable to powder-post beetle attack as well as termites.

Preservation: Sapwood is responsive to open tank and pressure treating systems; heartwood is believed to be difficult to impregnate.

Uses: Pallets, fenceposts, general construction, utility plywood, flooring, pulp and paper products.

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1963. The mechanical properties of 174 Australian timbers.
CSIRO Div. For. Prod. Tec. Pap. No. 25.
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the United States. Technical Bulletin No. 479. U.S.
Dept. of Agric.
3. Skolmen, R. G.
1974. Some woods of Hawaii. . .properties and uses of
16 commercial species. USDA For. Serv. Gen. Tech.
Rep. PSW-8. Berkeley, Calif.

EUCALYPTUS MARGINATA

JARRAH

Family: Myrtaceae

Other Common Names: None.

Distribution: Found in coastal belt in Southwestern Australia.

THE TREE Up to 100-150 ft in height with trunk diameters of 3 to 5 ft.

THE WOOD General Characteristics: Heartwood is light red to dark red when first cut turning to a rich mahogany-like hue on exposure; distinct from the narrow pale sapwood. Texture moderately coarse; grain is commonly interlocked or wavy, sometimes curly; without distinctive odor or taste. Gum veins or pockets are a common defect.

Weight: Basic specific gravity (ovendry weight/green volume) 0.68; air-dry density 54 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (2)*	9,880	1,480	5,190
12%	16,200	1,880	8,870

Janka side hardness 1,285 lb for green material and 1,915 lb for dry. Forest Products Laboratory toughness 126 in.-lb for green and 117 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Requires mild drying conditions to avoid checking and warp; collapse is not severe. Air drying prior to kiln drying is suggested. Kiln schedule T3-C2 is used for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 4.6%; tangential 6.6%. Movement in service is rated medium.

Working Properties: Because of high density and irregular grain the wood is difficult to work with hand and machine tools; blunting of cutters is moderate; gluing is good.

Durability: Heartwood is rated as very durable and highly resistant to termite attack. Reported to be resistant to marine borer attack.

Preservation: Rated as extremely resistant to preservative treatments (heartwood).

Uses: Dock and harbor work and other heavy construction, flooring, railroad crossties.

ADDITIONAL READING

1. Boaz, I. H.
1947. The commercial timbers of Australia. CSIRO, Melbourne.
2. Bolza, E., and N. H. Kloot.
1963. The mechanical properties of 174 Australian timbers. CSIRO Div. For. Prod. Tec. Pap. No. 25.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

EUGENIA SPP.

KELAT

Family: Myrtaceae

Other Common Names: Obar (Sabah), Makaasim (Philippines), Obah (Sarawak), Jaman (India), Thabye (Burma), Dangkhao, Mao (Thailand), Yasiyasi (Fiji Islands).

Distribution: Throughout the Indo-Malayan area and extending to the Western Pacific islands. A very large genus with many of the countries in this region reporting 50 to 150 species.

THE TREE Usually a small to medium-sized tree reaching a height of 40-90 ft; trunk diameters 18-24 in.; boles often fluted.

THE WOOD General Characteristics: Heartwood variable, grayish, golden-brown, or brown with tints of pink, red, or purple; sapwood lighter in color but not well defined. Texture moderately fine and even; grain interlocked; luster low; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies considerably with species, averaging about 0.65; air-dry density 50pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 16%	-- 16,850	-- 2,550	6,250 8,550
Green (4) 11%	11,345 13,770	1,560 1,830	5,530 8,440
Green (1) 12%	9,700 14,100	1,560 1,820	5,000 7,680

Janka side hardness 915-1,480 lb for dry material.
Forest Products Laboratory toughness 145 in.-lb
for green material and 116 in.-lb for dry (5/8-in.
specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to air dry slowly, if quartersawn seasons with little degrade; endsplitting and heart checks may be troublesome. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.5%; tangential 7.8%; volumetric 14.8%.

Working Properties: The timber saws and machines well and usually dresses smoothly, some roughness in turning.

Durability: Generally rated as moderately durable in ground contact and as moderately resistant to termite attack.

Preservation: Heartwood difficult to treat, absorption of only a few pounds per cubic foot are reported.

Uses: Fencing, domestic and industrial flooring, general construction, railroad crossties, furniture components. Bark of some species used for tanning.

ADDITIONAL READING

1. Bolza E., and N. H. Kloot.
1966. The mechanical properties of 81 New Guinea timbers.
CSIRO Div. For. Prod. Tec. Pap. No. 41.
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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
3. Lee, Y. H., and Y. P. Chu.
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EUSIDEROXYLON ZWAGERI

BELIAN
BORNEO IRONWOOD

Family: Lauraceae

Other Common Names: Tambulian (Philippines), Onglen, Ulin (Indonesia).

Distribution: Throughout the lowlands of Sabah extending into the remainder of Borneo, other Indonesian islands, and the Philippines; occasionally abundant.

THE TREE May reach a height of 100 ft, with trunk diameters of exploitable trees up to 36 in.

THE WOOD General Characteristics: Heartwood light brown to almost bright yellow when freshly cut, darkens on exposure to a deep reddish-brown, very dark brown, or almost black; sapwood bright yellow, darkening on exposure, sharply defined. Texture fine and even; grain straight or only slightly interlocked; somewhat lustrous; has a lemon-like odor that persists, no marked taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.86-0.92; air-dry density 64-71 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum
			crushing strength
	Psi	1,000 psi	Psi
Green (4)*	20,850	2,570	11,590
11%	25,810	2,650	13,620
Green (1)	19,500	2,620	11,570

Janka side hardness 2,845 lb for green material and 3,020 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to season easily with little degrade due to warping and checking. Kiln schedule T2-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 4.3%; tangential 7.5%.

Working Properties: In spite of its high density the wood can be sawn without difficulty, blunting of cutters is only moderate; machines cleanly; reported to be difficult to glue with the synthetic resins.

Durability: Heartwood is rated as very durable, service life of 50-100 years in ground contact is reported; immune to termite attack. A service life of 20 years and more for marine work in tropical waters is reported.

Preservation: Not treatable, but sapwood is responsive.

Uses: Heavy construction, marine work, boatbuilding, piling, printing blocks, specialty furniture, industrial flooring, roofing shingles, tool handles.

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2 vol.
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4. U.K.: F.P.R.L.
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Report on Overseas Timbers, For. Prod. Res. Lab. No. 14.

FAGRAEA SPP.

TEMBUSU

ANAN

Family: Loganiaceae

Other Common Names: Buabua (Fiji Islands), Urung (Philippines), Temasuk (Sabah), Tatraq, Trai (Cambodia), Tam Sao (Thailand), Tembesu (Indonesia), Anan, Ananma (Burma).

Distribution: Widely scattered throughout Indo-Malaya and the Pacific Islands; sometimes planted as an ornamental.

THE TREE Varies with species, may reach a height of 100 ft with a diameter of 30 in., boles may be clear to 60 ft, often fluted and irregular.

THE WOOD General Characteristics: Heartwood yellowish-brown to light brown, darkening on exposure to a deep golden- or orange-brown; sapwood generally lighter in color and not clearly defined. Texture variable from fine to somewhat coarse; grain straight to irregular; lustrous; has a distinct aromatic and somewhat acid odor when freshly cut but does not persist upon seasoning. Skin rashes may develop when handling green logs with bark on (*F. fragrans*).

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.65-0.80; air-dry density 50-63 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	15,800	2,660	7,340
12%	21,400	3,020	12,100
12% (4)	18,700	--	9,500

Janka side hardness 1,770 lb for green material and 2,120 lb for dry. Amsler toughness 298 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to season slowly, otherwise dries with little or no degrade. In Fiji quartersawing is suggested to minimize surface checking. No data available on kiln schedules. Shrinkage green to air dry: radial 1.1%; tangential 1.6%.

Working Properties: Considering the high density, the timber is easy to saw and machine, takes a good finish. Some species are rather abrasive and dull cutting edges, a good carving timber and turns well.

Durability: Heartwood is reported to be very durable in ground contact and very resistant to termite attack; resistance to marine borer attack is questionable.

Preservation: Sapwood is permeable; heartwood is not treatable.

Uses: Heavy construction, flooring, turnery, carvings, printing dies, specialty items (rulers, T-squares, straight edges), railroad crossties, boat construction.

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1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

FLINDERSIA SPP.

QUEENSLAND-MAPLE

Family: Rutaceae

Other Common Names: Silkwood, Maple silkwood (Australia), New Guinea silkwood (New Guinea), Australian-maple (Great Britain).

Distribution: Northern Queensland (Australia) and extending into New Guinea.

THE TREE May reach a height of 100 ft, with a trunk diameter of 3 ft.

THE WOOD General Characteristics: Heartwood brownish-pink, darkening to a medium brown shade; sapwood narrow, grayish. Texture medium; grain often interlocked, sometimes wavy or curly, producing a wide range of figure; silky luster; slightly scented when freshly cut.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45; air-dry density 35 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	7,240	1,330	3,680
12%	12,400	1,660	7,180
12% (<u>1</u>)	11,100	1,480	6,440

Janka side hardness 635 lb for green material and 725 lb for dry. Forest Products Laboratory toughness about 100 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons satisfactorily with some tendency to warp and collapse. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 3.5%; tangential 5.0%.

Working Properties: The timber works well in most hand and machine operations, torn grain is common when planing quartered surfaces, takes a good finish, nails and glues well.

Durability: Heartwood is rated nondurable.

Preservation: No information available.

Uses: Fine furniture and cabinetwork, decorative veneers, interior joinery, paneling, musical instruments, rifle stocks.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
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2. Bolza, E., and N. H. Kloot.
1966. The mechanical properties of 81 New Guinea timbers. CSIRO Div. For. Prod. technol. Pap. For. Prod. Aust. No. 41.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.

GARCINIA SPP.

KANDIS

Family: Guttiferae

Other Common Names: Laibu (Fiji Islands), Binukau, Haras, Gatasan (Philippines), Lobak (Brunei), Sikop (Sarawak).

Distribution: Indo-Malaysian region, extending into the Philippines, exploited as well in the Fiji Islands.

THE TREE Usually with a short straight bole, reaching 65 ft in Fiji; trunk diameters mostly 12 to 18 in.

THE WOOD General Characteristics: Heartwood variable with species, dark red-brown, deep red, or yellow- to orange-brown; sapwood straw to yellow-brown, not sharply defined. Grain usually straight; texture fine to intermediate; luster low; without distinctive odor or taste. A silica content of 0.03-1.62% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.65-0.85; air-dry density 50-65 pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Some species prone to checking and warping, quartersawing is suggested to minimize degrade. A kiln schedule similar to T2-C2 for 4/4 stock is used in the Fiji Islands. Shrinkage green to 12%: radial 2.3%; tangential 5.2%.

Working Properties: Generally reported to be difficult to work, some species are siliceous and dull cutting tools.

Durability: Most species are rated as nondurable, however G. ituman is classified as very durable.

Preservation: No data available.

Uses: Several species have edible fruits; G. ituman is used for turnery, rulers, chessmen; other species go into flooring, general construction, tool handles.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15. 2 vol.
3. Fiji: Department of Forestry.
1967. Fiji timbers and their uses. The properties and potential uses of Laubu (Garcinia myrtifolia). A summary of CSIRO investigations. Dep. For., Suva No. 17.

GLUTA SPP.
and MELANORRHOEA SPP.

RENGAS

Family: Anacardiaceae

Other Common Names: Thitsi, Thayet-thitsi (Burma), Rak (Thailand), Lingas (Philippines), Gluta, Thitsi (India).

Distribution: Indo-Malaysian region, reaching into Indonesia and the Philippines.

THE TREE Attains a height of 100 to 120 ft; with a trunk diameter of 20 to 40 in.; bole cylindrical to rather irregular.

THE WOOD General Characteristics: Heartwood deep blood-red, darkens on exposure, streaked with bands of darker color; sapwood light pink-brown to almost white, rather wide in most species. Texture rather fine to moderately coarse; grain straight to irregular; without characteristic odor or taste; mostly without luster. Bark and wood contain a strongly irritating sap which persists until thoroughly dried.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.60-0.65; air-dry density averaging 45 to 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	8,585	1,380	5,325
12%	10,070	1,660	8,135
Green (<u>2</u>)	11,820	2,030	6,020
12%	16,120	2,170	8,625

Janka side hardness 1,400 to 2,040 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to season well with little or no degrade due to warping or checking; dries moderately slowly with little shrinkage. No data available on kiln schedules. Shrinkage green to ovendry: radial 2.9%; tangential 5.3%.

Working Properties: Green material easier to cut than dry, works well with hand and machine tools and dresses smoothly, takes a high polish. Severe dulling of cutters due to silica content. Even when thoroughly dried, wood may still be a skin irritant to some.

Durability: Heartwood generally reported to be only moderately durable and not highly resistant to termite attack; sapwood vulnerable to powder-post beetle attack.

Preservation: Heartwood is not treatable; sapwood is permeable.

Uses: Furniture, turnery, cabinetwork, specialty items, decorative veneers, joinery.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers.
Malayan Forester 28(4):307-319.
3. Limaye, V. D.
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Indian For. Rec. 18(10):1-70.
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1932. Commercial timbers of India. Gov. of India.
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GMELINA ARBOREA

**GMELINA
GUMHAR**

Family: Verbenaceae

Other Common Names: Yemane (Burma, Malaya).

Distribution: India, Burma, and eastward to Vietnam; scattered occurrence but becomes frequent in moist localities in Burma. Widely planted throughout the lowland tropics, a favored plantation species.

THE TREE Forest-grown trees often reach a height of 100 ft; commonly with a trunk diameter of 2 ft. Plantation-grown stems may reach this size in 20 years on favorable sites.

THE WOOD General Characteristics: Pale straw-yellow, sometimes tinged with pink with no marked contrast between sapwood and heartwood. Grain interlocked, wavy; texture moderately coarse; lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.41; air-dry density 30 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (5)*	6,870	750	3,230
12%	8,650	800	4,900
Green (3)	6,940	1,120	3,300
12%	9,375	1,290	4,850

Janka side hardness 525 to 720 lb at 12% moisture content.

*See "Additional Reading" for references.

Drying and Shrinkage: Easy to air season with little or no degrade. Kiln schedule T13-C4S is suggested for 4/4 stock and T11-D3S for 8/4. Shrinkage green to ovendry: radial 2.4%; tangential 4.9%; volumetric 8.8%. Movement in service classified as small.

Working Properties: Easy to work with hand and machine tools and takes a smooth finish. Rotary peels well into veneers without heating of bolts. Easy to glue and nail.

Durability: Generally rated as nondurable but denser heartwood is moderately durable. Resistance to termite attack is variable.

Preservation: Heartwood is resistant to pressure treatments, absorbing only 2pcf of creosote; sapwood absorbed 7pcf in the same test.

Uses: General carpentry, furniture components, utility plywood, pulp and paper products, particleboard, matches, carvings, clogs.

ADDITIONAL READING

1. Douay, J.
1956. Gmelina arborea (Roxb.). Monographie Bois For. Trop. 48:25-38.
2. Lamb, A.F.A.
1968. Fast growing timber trees of the lowland tropics No. 1 Gmelina arborea. Comm. For. Inst. Dep. For. University of Oxford.
3. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1. Indian For. Rec. 18(10):1-70.
4. Nigeria: Department of Forest Research.
1965. Gmelina arborea (Gmelina). For. Prod. Res. Rep. Dept. For. Res. Nigeria No. F.P.R.L./2.
5. U.K.: F.P.R.L.
1967. Reports on overseas timbers. No. 7. Report on a consignment of Gmelina arborea Roxb. from Gambia, F.P.R.L. consignment No. 1359. Forest Prod. Res. Lab., Princes Risborough.

GONYSTYLUS SPP.
Principally G. BANCANUS

RAMIN

Family: Gonystylaceae

Other Common Names: Melewis (Malaya), Garu Buaja (Indonesia),
Lanutan-Bagio (Philippines).

Distribution: Found in peat swamp forests of Malaya through
parts of Sumatra, west coast of Borneo, and the
Philippines.

THE TREE A tall tree free of branches to 50 to 60 ft, bole straight,
cylindrical, sometimes fluted at the base; trunk
diameter commonly to 2 ft.

THE WOOD General Characteristics: Heartwood and sapwood creamy-white
to pale straw, not differentiated. Grain generally
straight or shallowly interlocked; texture fairly fine
and even; low in luster. The wood has an unpleasant odor
when freshly cut and this may return if dried wood becomes
wet. It is suggested that this occurs only in pond-stored
logs.

Weight: Basic specific gravity (ovendry weight/green volume)
0.52; air-dry density 41 pcf.

Mechanical Properties: (First set of data based on the 2-cm
standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 12%	10,300 19,400	1,470 2,030	5,620 10,500
12% (4)	17,700	2,170	8,650

Janka side hardness 640 lb for green material and
1,300 lb for dry. Amsler toughness 193 in.-lb at
12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries readily with little warp but with a marked tendency to end splitting and surface checking, end coating of boards is suggested. Kiln schedule T3-C2 is suggested for 4/4 stock and T2-C1 for 8/4. Shrinkage green to ovendry: radial 4.3%; tangential 8.7%; volumetric 13.4%. Movement in service is rated as large.

Working Properties: The timber is easy to saw and machine, dresses smoothly, glues and finishes satisfactorily. The wood has a marked tendency to split on nailing.

Durability: The wood is highly susceptible to attack by decay fungi, prone to blue stain; not resistant to termite attack. Freshly felled logs are liable to immediate attack by ambrosia beetles.

Preservation: The wood is easily treated using either open tank or pressure-vacuum systems; absorptions are over 25 pcf (creosote).

Uses: Furniture, joinery, moldings, paneling, flooring, turnery, plywood, nonstriking handles (brooms), dowels, picture frames, a general utility wood.

ADDITIONAL READING

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2. Farmer, R. H. (ed.).
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3. Lavers, G. M.
1967. The strength properties of timbers. Forest Prod. Res. Bull. No. 50. H. M. Stationery Office. London.
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GREVILLEA ROBUSTA

SILKY-OAK
GREVILLEA

Family: Proteaceae

Other Common Names: Southern silky-oak (Australia), Kawilia (Tanganyika), Lacewood (USA).

Distribution: Native to eastern Australia but planted extensively as a shade tree for coffee and tea plantations and as an ornamental in tropical and subtropical regions.

THE TREE Forest grown trees may reach a height of 150 ft with a trunk diameter of 4 ft. In plantations, boles usually 30 ft in length with diameter of about 2 ft.

THE WOOD General Characteristics: Heartwood pale pinkish-brown becoming yellow-brown on exposure; sapwood cream-colored, moderately well defined. Texture medium to coarse; grain straight to wavy; lustrous; because of large rays, figure is prominent on quartered faces. Some people develop skin rash when working green or dry wood.

Weight: Basic specific gravity (ovendry weight/green volume) 0.51; air-dry density 38pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (<u>1</u>)*	13,400	--	--
12% (<u>4</u>)	8,460	1,110	5,060

Janka side hardness 840 lb for dry material.
Forest Products Laboratory toughness 95 in.-lb at 12% moisture content (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The wood seasons well in 4/4 stock but thicker material requires slow air drying followed by a mild kiln schedule to avoid honeycombing. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 2.7%; tangential 7.7%.

Working Properties: The wood works well with hand and machine tools and dresses smoothly; has been rated very high in all-around machinability.

Durability: Heartwood is rated as moderately resistant to attack by decay fungi and termites; sapwood is perishable.

Preservation: Heartwood is treatable by open tank and pressure-vacuum systems; absorptions of creosote are about 8 to 20 pcf respectively.

Uses: Joinery, furniture, parquet flooring, decorative veneers, turnery, light construction work.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
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2. Farmer, R. H. (ed.).
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4. Tanganyika: Util. Div. For. Dep.
1962. Timbers of Tanganyika: Grevillea robusta. Utilization Section, Forest Division, Moshi.

HERITIERA SPP.
SYN. TARRIETIA SPP.

MENGKULANG

Family: Sterculiaceae

Other Common Names: Kembang (Sabah), Lumbayau (Philippines), Kanze (Burma), Chumprak (Thailand), Huynh (Cambodia).

Distribution: Indo-Malayan region extending into Indonesia, the Philippines, and other western Pacific islands.

THE TREE A medium-sized to large tree 100 to 150 ft in height; boles generally well formed and clear 60 to 80 ft, trunk diameters 2 to 4 ft above large buttresses.

THE WOOD General Characteristics: Heartwood various shades of brown, red-brown, or dark red-brown, sometimes with dark almost black streaks; sapwood 2 to 5 in. wide, lighter colored and not always sharply differentiated. Texture moderately coarse to coarse; grain straight to interlocked, and irregular; luster low to rather high; reported to have an unpleasant odor when freshly cut.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52 to 0.59; air-dry density 40 to 45 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,750	1,550	6,000
12%	16,000	1,740	8,800
Green (3)	11,800	1,700	5,770
12%	17,000	1,920	8,880

Janka side hardness 1,140 to 1,320 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons rapidly with some tendency to warping and surface checking. Kiln schedule T3-D2 is suggested for 4/4 stock and T3-D1 for 3/4. Shrinkage green to 15% moisture content: radial 1.6%; tangential 3.1%. Movement in service is rated as small.

Working Properties: The timbers are somewhat difficult to work due to the presence of silica (generally under 0.50%), cutters dull rapidly. Takes a smooth finish, rotary peels well, and has good gluing properties.

Durability: The heartwood is rated as nondurable, stake tests show an average service life of only 2 years. Not resistant to marine borers.

Preservation: The heartwood is reported to be moderately resistant to preservative treatments.

Uses: Classified as a general utility timber, flooring, plywood, furniture, interior finish, boatbuilding, decorative veneers.

ADDITIONAL READING

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2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
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HOMALIUM spp.

BURMA LANCEWOOD
MALAS

Family: Flacourtiaceae

Other Common Names: Myauk-chaw, Myaukugo (Burma), Puyot, Aranga (Philippines), Petaling padang, Selimbar (Malaya).

Distribution: Indo-Malayan region, extending into the Philippines, Indonesia, and New Guinea. Common throughout Burma.

THE TREE May reach a height of 100 ft; boles straight and cylindrical, clear to 50 ft; trunk diameters 2 to 4 ft.

THE WOOD General Characteristics: Wood reddish-brown, grayish-brown, or yellow-brown, sapwood and heartwood not clearly differentiated. Luster low; grain usually straight, sometimes slightly to deeply interlocked; texture fine and even; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.76; air-dry density 58pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)* 9%	13,190 19,165	1,890 2,200	6,880 10,050
13% (4)	15,200	2,260	6,030

Janka side hardness 1,850 to 2,690 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to be difficult to season, particularly prone to end and surface checking. No data available on kiln schedules. Shrinkage green to 15% moisture content: radial 1.1%; tangential 2.4%.

Working Properties: Rather high cutting forces are needed to saw and machine this wood because of the high density, otherwise works well and takes a smooth finish, excellent for turnery.

Durability: Generally reported to be durable to moderately durable and fairly resistant to termite attack.

Preservation: Heartwood absorption of preserving oils, using an open tank system, is only fair. Sapwood is reported to treat well.

Uses: Turnery, flooring, interior and exterior construction, furniture components, tool handles.

ADDITIONAL READING

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2. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1.
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3. Pearson, R. S., and H. P. Brown.
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4. Reyes, L. J.
1938. Philippines woods. Commonwealth of the Philippines. Dep. Agri. Comm. Tec. Bul. No. 7.
Manila.

HOPEA SPP.

THINGAN
MERAWAN

Family: Dipterocarpaceae

Other Common Names: Gagil (Sabah), Luis, Selangan (Sarawak), Manggachapui (Philippines), Koki (Cambodia), Mai Takien (Thailand).

Distribution: Throughout the Indo-Malayan region, Indonesia including Borneo and New Guinea, and the Philippines.

THE TREE A large tree up to 150 ft in height with a straight cylindrical bole clear to 80 ft; trunk diameters reaching 4 ft and more, slightly buttressed.

THE WOOD General Characteristics: Heartwood generally yellow when freshly cut sometimes light brown with a greenish or purplish cast, darkening on exposure to a golden- or red-brown; sapwood lighter in color and not sharply defined. Texture fine to medium and even; grain usually interlocked; luster rather low; without distinctive odor or taste. Prominent vertical resin canals produce conspicuous white streaks.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species averaging about 0.64; air-dry density 48 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)* 12%	13,100 16,860	1,560 1,870	6,750 8,760
Green (2) 12%	10,500 15,400	1,670 2,300	5,950 8,450

Janka side hardness 1,050 to 1,460 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly, liable to surface checking and end splitting but with little warp. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 3.4%; tangential 6.5%; volumetric 9.3%. Movement in service is rated as small.

Working Properties: Generally reported to be easy to work though somewhat difficult to saw; worked surfaces are smooth; turns easily and cleanly.

Durability: Reported to be durable in ground contact and resistant to termite attack.

Preservation: Heartwood is classified as extremely resistant to preservative treatments; sapwood is permeable, absorbing well over 12 pcf of preservative oils using a pressure-vacuum system.

Uses: General construction, boatbuilding, furniture components, flooring, railroad crossties, joinery, turnery.

ADDITIONAL READING

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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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4. U.K.: F.P.R.L.
1967. Report on a consignment of Gagil (Hopea sangal) from Sabah. F.P.R.L. Consignment No. 1310. Reports on Overseas Timbers, Princes Risborough Laboratory No. 6.

INTSIA BIJUGA
and I. PALEMBANICA

MERBAU
IPIL

Family: Leguminosae

Other Common Names: Tat-talun (Burma), Lumpha, Lumpho (Thailand), Kwila (New Guinea), Vesi (Fiji Islands), Ipil (Philippines), Merbau (Malaya).

Distribution: Indo-Malayan region, Indonesia, Philippines, and many of the western Pacific islands as well as Australia. May be locally common in lowland forests, transition zones behind mangroves.

THE TREE A large tree often with a rather short, thick bole, sometimes to 50 ft, often fluted; trunk diameters to 5 ft above large spreading buttresses.

THE WOOD General Characteristics: Heartwood yellowish- to orange-brown when freshly cut, turning brown or dark red-brown on exposure; sapwood pale yellow to light buff, sharply demarcated from the heartwood. Texture rather coarse; grain straight to interlocked or wavy; luster variable; has a characteristic odor when dry material is worked, and an astringent taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.68; air-dry density 50pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>4</u>)*	12,850	2,020	6,770
15%	16,810	2,230	8,440
Green (<u>1</u>)	15,000	2,150	8,040
12%	21,300	2,610	11,700
12% (<u>5</u>)	20,000	2,320	9,500

Janka side hardness 1,500 to 1,925 lb for dry material. Forest Products Laboratory toughness about 190 in.-lb average for wet and dry material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little degrade. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 2.7%; tangential 4.6%; volumetric 7.8%. Movement in service is rated as small.

Working Properties: Rather difficult to saw because of gumming of teeth and dulling of cutting edges, dresses smoothly in most operations, finishes well. Stains black in the presence of iron and moisture.

Durability: Heartwood has an average service life of 6 years in Malayan stake tests but generally reputed to have good durability; highly resistant to termite attack. Sapwood prone to powder-post beetle attack.

Preservation: Heartwood is impermeable, but sapwood is treatable.

Uses: Flooring, furniture, paneling, fine joinery, decorative turnery, cabinetmaking, musical instruments, specialty items. The wood is also a dye source.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
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KOOMPASSIA MALACCENSIS

KEMPAS

Family: Leguminosae

Other Common Names: Impas (Sabah), Mengris (Sarawak).

Distribution: Malaysia and Indonesia; throughout lowland forests in rather swampy areas and also on hillsides.

THE TREE May reach a height of 180 ft with clear, usually straight boles to 80 to 90 ft, trunk diameters may reach 6 ft and more over heavy buttresses.

THE WOOD General Characteristics: Heartwood brick-red when freshly cut, darkening on exposure to an orange-red or red-brown with numerous yellow-brown streaks due to soft tissue associated with the pores; sapwood white or pale yellow about 2 in. wide in large trees and clearly defined. Grain typically interlocked, sometimes wavy; texture rather coarse; luster variable; odor and taste not distinctive. The timber is slightly acidic and may be corrosive to metals. Streaks of brittle stone-like tissue are fairly common and are a source of mechanical weakness.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72; air-dry density 55 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	14,530	2,410	7,930
15%	17,680	2,690	9,520

Janka side hardness 1,480 lb for green material and 1,710 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber usually dries well though with some tendency to warping and checking. If included phloem is present, splits are liable to develop. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 6.0%; tangential 7.4%; volumetric 14.5%. Reported to hold its place well once seasoned.

Working Properties: The timber is difficult to work with hand and machine tools; dresses to a reasonably smooth surface.

Durability: Reported to be resistant to attack by decay fungi but vulnerable to termite activity, both subterranean and dry-wood. Sapwood liable to powder-post beetle attack.

Preservation: Reported to treat readily with absorptions of preservative oils as high as 20pcf.

Uses: Heavy construction work, railroad crossties, plywood core stock, parquet flooring, pallets, (should be treated where termite attack may be a particular hazard).

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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1965. The strength properties of Malayan timbers. Malayan Forester 28(4):307-319.

KOORDERSIODENDRON PINNATUM

RANGGU

Family: Anacardiaceae

Other Common Names: Amugis (Philippines).

Distribution: Philippines, Celebes, and Borneo (including Sabah); a scattered tree in lowland forests.

THE TREE Reaches a height of 120 ft with trunk diameters usually 24 to 30 in.; buttressed to a height of about 5 ft.

THE WOOD General Characteristics: Heartwood medium red-brown to a dark red; sapwood white, pinkish, or grayish-brown, clearly defined. Texture rather fine and even; grain interlocked, sometimes slightly wavy or curly; luster variable; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.65 to 0.72; air-dry density 50 to 55 pcf.

Mechanical Properties: (2-cm standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	15,580	1,900	8,130
12%	22,420	2,250	11,210

Janka side hardness 1,705 lb for green material and 1,860 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Dries with some degrade due to splitting and shake; warp is also a problem, particularly cup. Kiln schedule T13-C4S is suggested for 4/4 stock and T11-D3S for 8/4. Air drying prior to kiln drying of thick lumber is also suggested. Shrinkage green to 12% moisture content: radial 3.5%; tangential 6.5%. Movement in service is rated as small.

Working Properties: Works adequately with most tools, band resaw rather than a circular blade is recommended for ripping. Dresses to a smooth finish but torn grain is common on quartered faces. Requires firm support at exit faces in mortising and boring.

Durability: Heartwood is only moderately durable to nondurable and is not resistant to termite attack. Standing trees are liable to longhorn beetle damage.

Preservation: Heartwood is extremely resistant to preservation treatments; sapwood is rated as moderately resistant.

Uses: Flooring, furniture components, turnery, general joinery.

ADDITIONAL READING

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Reports on Overseas Timbers, Forest Prod. Res. Lab.
No. 15.

LAGERSTROEMIA spp.

PYINMA

Family: Lythraceae

Other Common Names: Jarul (India), Banglang (Vietnam), Intanin (Thailand), Bungor (Malaya, Sabah), Banaba (Philippines), Bang-lang (Cambodia).

Distribution: Indo-Malayan region including Indo-China and extending into Indonesia and the Philippines; along rivers and on moist flat land; often cultivated as an ornamental.

THE TREE Reaches a height of 100 ft with trunk diameters of 3 to 4 ft on favorable sites; boles to 40 ft in length, often fluted.

THE WOOD General Characteristics: Heartwood light red to reddish-brown, darkening on exposure; sapwood light yellow-brown to grayish-white, rather wide. Grain usually straight; texture moderately fine to rather coarse; rather lustrous; without distinctive odor or taste. Wavy grain, if present, and semiring porous growth produce an attractive figure.

Weight: Basic specific gravity (ovendry weight/green volume) 0.55; air-dry density 43 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 8%	8,590 13,255	1,285 1,535	4,275 7,250
Green (2) 12% (4)	9,200 14,800	1,290 --	4,400 9,300

Janka side hardness about 1,055 lb for dry material. Amsler toughness 250 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: reported to be easy to season with little or no degrade due to warping and checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.4%; tangential 6.8%; volumetric 12.7%.

Working Properties: The timber saws and works well, finishes to a smooth surface, and takes a good polish.

Durability: Generally classified as moderately durable and somewhat resistant to termites. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood reported to be very difficult to treat with absorptions of preservative oils less than 2 pcf using a pressure-vacuum system.

Uses: Furniture, interior joinery, boatbuilding, general construction, parquet flooring, paneling.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
3. Limaye, V. D.
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1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

LITSEA SPP.

MEDANG

Family: Lauraceae

Other Common Names: Boi loi (Vietnam), Medang padang (Sarawak), Batikuling (Philippines), Ondôn (Burma), Bollywood (Australia).

Distribution: Indo-Malayan region, extending into Indonesia, the Philippines, Australia, and the Pacific Islands.

THE TREE A small to moderate-sized tree, up to 40 ft in height with trunk diameters of 1 to 2 ft.

THE WOOD General Characteristics: Heartwood very variable greenish-yellow, yellowish- or olive-gray, olive brown, grayish-brown, sometimes with dark streaks; sapwood lighter in color, not distinct. Grain straight to wavy; texture fine to somewhat coarse; lustrous when first cut but becoming dull with exposure; some species scented, others with an unpleasant odor when fresh that does not persist.

Weight: Basic specific gravity (ovendry weight/green volume) variable with species, mostly about 0.40; air-dry density 31 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)* 16%	7,370 9,250	1,370 1,470	3,650 5,070
Green (1) 12%	7,420 10,900	1,370 1,700	3,500 5,860
12% (4)	14,300	--	7,650

Janka side hardness 525 to 600 lb for dry material. Forest Products Laboratory toughness 83 in.-lb for green wood (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to season well with little or no degrade. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.6%; tangential 7.0%; volumetric 10.1%.

Working Properties: Very easy to work with hand and machine tools, a favored carving wood in the Philippines. Sawdust may be a skin irritant.

Durability: Variable with species; L. sebifera is rated as durable in India and L. polyantha as perishable.

Preservation: Heartwood is reported difficult to treat; sapwood is receptive.

Uses: Joinery, carving, patternmaking, furniture, light construction, rotary-cut veneer.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
1963. The mechanical properties of 174 Australian timbers. Div. For. Prod. technol. Pap. For. Prod. Aust. No. 25.
2. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers. Malayan Forester 28(4):307-319.
3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India. Central Publ. Br., Calcutta.
4. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

LOPHOPETALUM SPP.

PERUPOK

Family: Celastraceae

Other Common Names: Taung-yemaré (Burma), Banate, Balpale (India), Seng sa, Song sa (Thailand), Mata ulat (Malaya), Dual, Adau (Brunei), Sang trang (Vietnam).

Distribution: Indo-Malayan region, North Borneo, and Indonesia.

THE TREE Boles are cylindrical, straight, and clear to 40 ft, trunk diameters 24 to 30 in.

THE WOOD General Characteristics: Heartwood light yellow, light pinkish- or brownish-gray, or brown with a purple cast, mottled with light brown on the tangential surface; sapwood not clearly differentiated. Texture fine to medium and even; grain fairly straight to interlocked; luster medium; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.40-0.52; air-dry density 30 to 40 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	8,580	1,165	--
12% (4)	11,500	--	5,700

Amsler toughness 172 in.-lb at 12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to season well with only slight checking and little or no warping. No data available on kiln schedules. Shrinkage green to ovendry: radial 3.5%; tangential 5.9%; volumetric 9.4%.

Working Properties: Reported to be very easy to saw and work, takes a fine finish, easy to rotary peel into veneers.

Durability: Heartwood is vulnerable to attack by decay fungi.

Preservation: Heartwood treated with preservative oils using an open-tank system absorbed about 1 pcf, sapwood absorbed about 7 pcf.

Uses: Plywood, joinery, furniture components, light construction.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan Forest Rec. 15. 2 vol.
3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India. Central Publ. Br., Calcutta.
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1955. Propriétés physiques et mécaniques des bois tropicaux de l'union Française. Publ. Centre Tech. For. Trop. No. 8.

MACHILUS SPP.

MACHILUS

Family: Lauraceae

Other Common Names: Kulilisiau (Philippines), Seiknangyi (Burma), Pau hoi (China).

Distribution: India, Malay Archipelago, and northward to the Philippines, Japan, and China.

THE TREE Variable with species, may reach a height of 80 ft; trunk diameters 24-30 in., sometimes to 36 in.; boles fairly straight and cylindrical, 20-30 ft in length.

THE WOOD General Characteristics: Heartwood gray, grayish-brown, brown, reddish-brown, to dark olive-buff; sapwood yellowish, yellow-brown, grayish, not sharply demarcated. Grain straight to irregular and interlocked; texture fine to medium; dull to lustrous; without characteristic taste, but sometimes with a sweet cedar odor when freshly cut.

Weight: Basic specific gravity (ovendry weight/green volume) variable with species, generally 0.40-0.46; air-dry density 30-35 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	7,255	1,090	3,585
14%	8,070	1,120	4,110
12% (<u>2</u>)	8,400	1,260	4,840

Janka side hardness 630 lb for dry material.

*See "Additional Reading" for references.

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Drying and Shrinkage: Easy to season with little or no degrade; reported to kiln dry without difficulty though no data are available on kiln schedules. Shrinkage green to ovendry: radial 2.8%; tangential 6.0%; volumetric 10.2%.

Working Properties: Easy to work with hand and machine tools, dresses to a smooth finish.

Durability: Generally reported to be only moderately durable when in ground contact.

Preservation: No information available.

Uses: Carving, furniture, light construction, joinery, veneer and plywood, musical instruments. A mucilaginous extract has been made from wood shavings in China and used as a hair pomade.

ADDITIONAL READING

1. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1. Indian For. Rec. 18(10):1-70.
2. Pearson, R. S., and H. P. Brown.
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1938. Philippine woods. Commonwealth of the Philippines. Dep. Agri. Comm. Tec. Bul. No. 7. Manila.

MANGIFERA SPP.

MANGO

MACHANG

Family: Anacardiaceae

Other Common Names: Thayet (Burma), Membatjang, Mangga (Indonesia), Xoai (Indochina), Asam (Sabah), Malapaho, Pahutan (Philippines).

Distribution: Throughout tropical Asia, most species found in Malaya. *M. indica* produces the mango fruit of commerce and has been introduced throughout tropical and subtropical areas of the world.

THE TREE Varies with species, may reach a height of 80-100 ft with boles to 65 ft; trunk diameters 3-4 ft; sometimes with small to prominent buttresses. Open-grown trees cultivated for the fruit have a short main stem with massive branching. Skin of fruit may cause a rash.

THE WOOD General Characteristics: Heartwood light pinkish-brown, light brown, dark brown, or golden, black streaks sometimes present; sapwood not always clearly defined; texture moderately fine to coarse; grain interlocked, sometimes straight; lustrous; without distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45-0.58; air-dry density 35-45 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	8,710	1,300	4,180
12%	12,680	1,580	6,225
Green (2)	9,400	1,450	4,420
12%	14,900	1,910	7,550

Janka side hardness about 1,000 lb for dry material. Forest Products Laboratory toughness 298 in.-lb for green material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little or no degrade. Can be kiln dried from the green condition using a harsh schedule, but actual schedules used are not available. Shrinkage green to ovendry: radial 3.0%; tangential 4.9%; volumetric 7.3%. Movement in service has been rated as small.

Working Properties: Generally reported to be easy to work, but smoothness of cut varies with grain irregularities, torn grain is common; finishes and polishes well.

Durability: Heartwood is vulnerable to attack by decay fungi as well as termites.

Preservation: Both heartwood and sapwood are treatable with preservative oils using an open tank system; an absorption of 7 pcf is reported.

Uses: Joinery, furniture components, face veneers and core-stock for plywood, turnery, flooring.

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1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
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1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

MELALEUCA QUINQUENERVIA
SYN. M. LEUCADENDRON

BROAD-LEAVED TEA-TREE
CAJEPUT

Family: Myrtaceae

Other Common Names: Gelam (Malaya), Niaouli (New Caledonia),
Cajeput (U.S.A.), Paper-bark (Australia).

Distribution: Native to eastern Australia, Malay Archipelago,
New Caledonia, and New Guinea; grows in pure stands on wet
coastal flats and brackish swamps. The tree has been widely
planted in other tropical and subtropical areas, often
becoming naturalized.

THE TREE May reach a height of 80-100 ft; usually 1-2 ft in diameter;
boles frequently gnarled and twisted. The tree coppices
easily. The thick spongy bark is distinctive and can be
peeled off in large flakes.

THE WOOD General Characteristics: Heartwood pinkish-brown; sapwood
paler and rather ill-defined. Grain straight to irregular
or wavy; texture fine and uniform; lustrous; without
distinctive odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume)
0.65; air-dry density 50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	11,900	--	5,920

Janka side hardness 1,530 lb for green material.
Forest Products Laboratory toughness 175 in.-lb
for green material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Difficult to season, prone to checking and warping; quartersawing may minimize degrade. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.0%; tangential 9.5%; volumetric 16.2%.

Working Properties: Readily worked with hand and machine tools and takes a good finish. Rather rapid dulling of cutters is reported. A silica content of 0.20-0.95% is reported.

Durability: Heartwood durable in ground contact; also resistant to termite attack and marine borer activity. Sapwood liable to powder-post beetle attack.

Preservation: No information available.

Uses: Carvings, cabinetwork, boatbuilding, fencing, railroad crossties, mine props, marquetry, veneers, gun stocks. The leaves are distilled to yield an oil used for medicinal purposes; corky bark flakes have also been used for insulation as well as stuffing for pillows, etc.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
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1960. Specimen Woods No. 294. Broad-leaved Tea-tree (Melaleuca leucadendron). Suppl. to Wood 25(6).

MELIA AZEDARACH

PERSIAN LILAC
CHINABERRY TREE

Family: Meliaceae

Other Common Names: Tamaga (Burma), Bois rouge (New Caledonia), Chinaberry tree (U.S.A.).

Distribution: Native to the Himalayan region and perhaps elsewhere in Asia. Cultivated throughout the tropical and subtropical regions of the world as an ornamental.

THE TREE Open-grown trees with straight, fairly cylindrical boles to a length of 12 ft; trunk diameters 1-2 ft. Bark, leaves, and fruit have some medicinal applications.

THE WOOD General Characteristics: Heartwood reddish, darkening on exposure to a reddish-brown, marked with dark striations caused by zones of springwood pores; sapwood yellowish-white, distinct. Grain straight; texture coarse and uneven; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.47; air-dry density 36pcf.

Mechanical Properties: (First set of data based on the 2-cm standard, the second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (3)*	16,000	1,300	8,100
Green (1)	8,500	1,150	3,920

Amsler toughness 327 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The timber seasons exceptionally well with little or no degrade due to warping or checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 5.0%; tangential 8.5%; volumetric 13.5%.

Working Properties: Easy to saw and machine, and peels well on a veneer lathe; dresses to a smooth finish and takes a good polish.

Durability: The timber is reported to be resistant to attack by decay fungi and termites.

Preservation: No information available.

Uses: Turnery, furniture components, decorative veneers, novelty items, boxes and chests.

ADDITIONAL READING

1. India: For. Res. Inst. and Colleges.
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2. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.
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MESUA FERREA

GANGAW

Family: Guttiferae

Other Common Names: Mesua (India), Penaga (Malaya),
Bosnéak (Cambodia).

Distribution: Widely distributed in the forests of India and
Ceylon and extending into Indonesia, Malaya, and
Cambodia.

THE TREE A large tree, often buttressed at the base; trunk diameters
up to 3 ft.

THE WOOD General Characteristics: Heartwood dark red or deep reddish-brown;
sapwood pale whitish- or pinkish-brown, rather wide, sharply
differentiated. Texture even and rather fine; grain straight
to interlocked; somewhat lustrous; without characteristic
odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume)
0.80-0.85; air-dry density 60-66 pcf.

Mechanical Properties: (First set of data based on the 2-cm
standard, the second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
12% (4)*	23,100	--	15,200
Green (2)	16,585	2,320	8,835
12%	24,065	2,865	12,430

Janka side hardness 2,190 lb for green material and
2,890 lb for dry. Amsler toughness 270 in.-lb at
12% moisture content (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The timber seasons slowly and is particularly prone to checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 6.0%; tangential 9.5%; volumetric 15.8%.

Working Properties: The wood is very difficult to saw, even when green; machines moderately well, but is liable to torn grain when dressing quartered faces.

Durability: The timber is rated durable in ground contact and is rarely attacked by termites.

Preservation: No information available.

Uses: Railway crossties, heavy construction, boatbuilding, mine props, tool handles.

ADDITIONAL READING

1. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15. 2 vol.
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METROSIDEROS COLLINA subsp. POLYMORPHA

OHIA

Family: Myrtaceae

Other Common Names: Vuga (Fiji Islands), Anume (Samoa).

Distribution: Islands of the Pacific. Most abundant of the indigenous Hawaiian trees and may form large, almost pure stands. A pioneer species that is one of the first invaders of disturbed areas.

THE TREE May reach a height of 100 ft, boles with clear lengths of 40-50 ft, straight or twisted; diameters to 4 ft. Trees often have prop or stilt roots.

THE WOOD General Characteristics: Heartwood reddish- to purplish-brown; grading gradually into the pale brown sapwood. Texture fine to medium; grain usually interlocked; lustrous; without characteristic odor or taste. Color banding in the growth rings together with interlocked grain produces an attractive figure.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 57pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,100	1,800	4,720
12%	18,300	2,370	8,900

Janka side hardness 1,270 lb for green material and 2,090 lb for dry. Forest Products Laboratory toughness 410 in.-lb for green and 385 in.-lb for dry condition (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber is prone to warping, air-drying is suggested prior to kiln drying. A kiln schedule similar to T3-C2 is used in Fiji for 4/4 stock. Shrinkage green to ovendry: radial 6.9%; tangential 12.1%; volumetric 19.1%. Movement in service is rated as large.

Working Properties: The wood saws and machines with difficulty because of high density; works well (defect-free) in shaping and boring but rates poorly in planing and turning.

Durability: Heartwood is not resistant to attack by decay fungi; has good resistance to subterranean and dry-wood termites.

Preservation: Heartwood reported to be resistant to penetration; sapwood has good absorption and penetration.

Uses: Strip flooring, pallets, pile-driver cushions, poles and posts, wharf fenders.

ADDITIONAL READING

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1971. The properties and potential uses of Vuga (Metrosideros collina). A summary of C.S.I.R.O. investigations. Fiji Timb. No. 52.
2. Skolmen, R. G.
1974. Some woods of Hawaii. . .properties and uses of 16 commercial species. USDA For. Serv. Gen. Tec. Rpt. PSW-8.
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1960. Physical, mechanical, and other properties of five Hawaiian woods. USDA For. Serv. For. Prod. Lab. Rpt. No. 2191.

MICHELIA SPP.

CHAMPACA

Family: Magnoliaceae

Other Common Names: Saga, Sagawa, Sanga (Burma), Chempaka (Malaya), Sandit, Hangilo (Philippines).

Distribution: Indo-Malayan region and extending into the Philippines, Indonesia, and Taiwan. Mostly confined to hilly regions and mountain slopes. Cultivated extensively.

THE TREE Straight cylindrical boles to 50 ft; with trunk diameters of 24-36 in.; may reach a height of 150 ft with diameters of 7 ft.

THE WOOD General Characteristics: Heartwood light yellowish-brown to olive-brown; sapwood whitish to light-brown, fairly distinct from the heartwood. Grain straight to interlocked; texture rather fine to medium; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.43; air-dry density 31 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	8,010	1,195	4,020
9%	9,250	1,390	6,420
Green (2)	7,665	1,440	3,825
12%	11,465	1,650	5,960

Janka side hardness 650-800 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to season well with little or no warping and checking. No data available on kiln drying schedules. Shrinkage green to ovendry: radial 3.2%; tangential 5.2%; volumetric 8.2%.

Working Properties: Easy to work with hand and machine tools, takes a good finish. Specimens with whitish deposits dull cutters. Easy to peel into veneers.

Durability: Reported to be moderately durable and resistant to attack by termites.

Preservation: No information available.

Uses: Furniture, carvings, general light construction, plywood, carvings and turnery, cabinetwork, patternmaking, joinery.

ADDITIONAL READING

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1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1.
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1938. Philippine woods. Commonwealth of the Philippines.
Dep. Agric. and Comm. Tec. Bul. No. 7. Manila.

MYRISTICA spp.
and KNEMA spp.

DARAH DARAH

Family: Myristicaceae

Other Common Names: Kaudamu (Fiji Islands), Penarahan (Malaya), Kumpang (Sarawak), Duguan, Tambolau (Philippines), Mutwinda (Burma).

Distribution: Indo-Malayan region, Indonesia, Philippines, and Western Pacific Islands. *M. fragrans* is cultivated for its seed kernels (nutmegs of commerce).

THE TREE A medium to large tree 60-90 ft in height; trunk diameter 12-30 in.; bole straight and cylindrical, sometimes with a moderate buttress.

THE WOOD General Characteristics: Heartwood light reddish-brown, dull brown, or brownish- or olive-gray; sapwood lighter in color, poorly differentiated. Texture rather fine to slightly coarse; grain straight; somewhat lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.45-0.60; air-dry density ranges from 35 to 45 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	--	--	5,100
16%	--	--	6,329

Janka side hardness about 1,020 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber dries rather slowly but with little degrade, thin stock tends to warp. A kiln schedule similar to T10-D4S is used for 4/4 stock in Fiji.
Shrinkage green to ovendry: radial 4.6%; tangential 6.9%; volumetric 12.4%.

Working Properties: The timbers are easy to work with hand and machine tools; dresses rather smoothly; tends to split on nailing.

Durability: Heartwood is vulnerable to attack by decay fungi and termites. Sapwood liable to powder-post beetle attack.

Preservation: Absorptions of about 10-30pcf of preservative oils have been obtained using open tank treating methods.

Uses: Light framing, joinery, furniture components, general carpentry work.

ADDITIONAL READING

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2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15. 2 vol.
3. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers. Malayan Forester 28(4):307-319.
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1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

NOTHOFAGUS SPP.

TASMANIAN-MYRTLE

Family: Fagaceae

Other Common Names: Myrtle Beech, Tasmanian Beech (Australia), Mountain Beech, Silver Beech (New Zealand).

Distribution: Southernmost part of Victoria and reaching over to Tasmania (Australia) and extending to New Zealand with principal production resources in the West Coast and Southland regions of South Island.

THE TREE Commonly reaches a height of 100 ft with a clear bole of 40 ft; trunk diameters 2-5 ft; sometimes buttressed.

THE WOOD General Characteristics: Heartwood pink or reddish-brown; sapwood paler, narrow, separated from the heartwood by a zone intermediate in color. Texture fine and uniform; grain generally straight, sometimes interlocked, wavy, or curly; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.43-0.58; air-dry density 33-45 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	10,300	1,680	4,780
12%	15,700	1,970	8,170
Green (<u>3</u>)	7,000	1,130	3,200
12%	11,500	1,480	5,500
Green (<u>3</u>)	8,000	1,380	3,600
12%	15,500	2,040	7,800

Janka side hardness 1,000 lb for green material and 1,325 lb for dry. Forest Products Laboratory toughness 138 in.-lb for green and 125 in.-lb for dry material (5/8-in. specimen).

*See "Attached Reading" for references.

Drying and Shrinkage: Generally prone to collapse, internal checking, and warping. Preliminary air drying followed by careful kiln drying, including reconditioning, can minimize degrade. Kiln schedule T3-C2 is suggested for 4/4 Australian material and T6-D2 for Silver Beech from New Zealand. Shrinkage green to air dry for Silver Beech: radial 3.1%; tangential 5.7%; volumetric 9.3%.

Working Properties: The timber can be worked readily in most hand and machine operations, excellent turnery; good steam bending properties; takes a satisfactory finish.

Durability: Heartwood is classified as nondurable; species with well-defined dark colored heartwood, though, are rated as durable in New Zealand. Sapwood is liable to powder-post beetle attack.

Preservation: Sapwood and intermediate "white wood" is permeable; heartwood is resistant to preservation treatments.

Uses: Furniture components, turnery, flooring, plywood, food containers, patternmaking, carving, joinery, brush and broom handles, pulp and paper, dowels.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
1963. The mechanical properties of 174 Australian timbers.
Div. For. Prod. Tec. Pap. For. Prod. Aust. No. 25.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
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3. New Zealand: For. Serv.
1974. Timber properties and uses of the New Zealand beeches. New Zealand For. Serv. Wellington.

OCTOMELES SUMATRANA

BINUANG

Family: Tetramelaceae

Other Common Names: Erima, Ilimo (New Guinea), Benuang (Indonesia).

Distribution: Extends from Sumatra to Papua and the Solomons and northwards to the Philippines; a low altitude riverine species, often in almost pure stands.

THE TREE Reaches a height over 180 ft with a clear bole 70 ft or more, good form; trunk diameters 5 ft or more. Some trees have heavy buttresses that may reach 12-15 ft above the base.

THE WOOD General Characteristics: Heartwood pale yellow, buff to pale brown or pinkish-brown; sapwood whitish, wide, not always clearly defined. Grain interlocked; texture coarse; luster low; without distinctive odor or taste. Brittle heart is frequently present.

Weight: Basic specific gravity (ovendry weight/green volume) 0.32; air-dry density 23 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (1)*	5,250	950	3,300
12%	7,700	1,190	5,270
Green (4)	5,400	770	3,160
12%	7,550	915	4,800

Janka side hardness 355-370 lb for dry material. Forest Products Laboratory toughness 54 in.-lb for green material and 44 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Dries slowly with severe degrade in the heartwood-sapwood zone. Some sources report this wood to dry without difficulty. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to 12% moisture content: radial 3.0%; tangential 7.0%. Movement in service is rated as small.

Working Properties: The timber works easily with hand and machine tools but sharp knives are needed to avoid a woolly finish; a poor finish is usually obtained in cross-cutting and drilling; nails satisfactorily.

Durability: Heartwood is perishable and highly susceptible to termite attack. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is moderately resistant to preservative treatments, sapwood, however, is responsive to both open tank and pressure-vacuum systems.

Uses: Backs and cores of plywood, form work, light construction, furniture components, burial caskets, cabinetwork, shingles and shakes.

ADDITIONAL READING

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1966. The mechanical properties of 81 New Guinea timbers.
Div. For. Prod. Tech. Pap. For. Prod. Aust. No. 41.
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1966. Timbers of Sabah. Sabah For. Rec. No. 6.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
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4. Lavers, G. M.
1967. The strength properties of timbers. For. Prod. Res. Bul. No. 50. H. M. Stationery Office. London.

PALAQUIUM spp.
and PAYENA spp.

NYATOH

Family: Sapotaceae

Other Common Names: Bauvudi (Fiji Islands), Nato (Philippines), Njatuh (Indonesia), Jangkar (Sarawak). This is a commercial grouping of species that weigh mostly 38-45 pcf air-dry.

Distribution: Widely distributed from India through Southeast Asia to the Philippines, New Guinea, and the Western Pacific Islands.

THE TREE Often 100 ft or more in height; trunk diameters up to 3 ft, stems may be fluted.

THE WOOD General Characteristics: Heartwood varies from pale pink to red-brown or purple-brown; sapwood lighter in color, not sharply defined. Grain straight to shallowly interlocked; texture moderately fine, even; has a sour smell when freshly milled; sometimes shows an attractive moire or "watered silk" figure.

Weight: Basic specific gravity (ovendry weight/green volume) varies considerably with species but commercial grouping is mostly 0.50-0.60; air-dry density 38-45 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
14% (2)*	14,445	1,965	7,625
17% (2)	10,050	1,480	4,040

Janka side hardness 840-1,195 lb for air-dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to dry rather slowly but with some tendency to end split and warp. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to air dry: radial 1.3-3.0%; tangential 2.3-4.0%.

Working Properties: Nonsiliceous species saw easily and dress to a smooth surface, there is some gum buildup on cutters. Species with silica are extremely abrasive and are difficult to saw with standard mill equipment.

Durability: Generally rated as nondurable and has a low resistance to termite attack. Sapwood liable to powder-post beetle attack.

Preservation: Heartwood is very resistant to preservative treatments; sapwood is treatable.

Uses: Furniture, interior joinery, plywood, a general utility wood. The bark is laticiferous and some species are worked to produce gutta-percha.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
4. U.K.: Wood.
1969. World timbers: No. 99. Nyatoh (principally *Palaquium* spp. and *Payena* spp.) Suppl. to Wood 34(1).

PARASHOREA SPP.

WHITE SERAYA

Family: Dipterocarpaceae

Other Common Names: Bagtikan (Philippines), Urat mata (Sabah).

Distribution: This wood is produced mainly by two species and is available commercially from Sabah and the Philippines; rather abundant.

THE TREE A very large tree, reaching 200 ft in height, straight, clear, cylindrical boles to 100 ft; trunk diameters 3-5 ft or more above large buttresses.

THE WOOD General Characteristics: Heartwood straw colored or light brown, sometimes with a pinkish tint; sapwood paler in color, not clearly defined, usually 2-1/2 to 3 in. wide. Texture moderately coarse; grain interlocked; without characteristic odor or taste. Brittleheart frequently present.

Weight: Basic specific gravity (ovendry weight/green volume) 0.44; air-dry density 33 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	9,850	1,700	4,750
12%	14,500	1,990	7,600
Green (4)	8,850	1,320	4,630
12%	11,700	1,400	7,000

Janka side hardness 665-785 lb for green material and 710-965 lb for dry. Forest Products Laboratory toughness 380 in.-lb green and 316 in.-lb dry (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: The timber seasons fairly rapidly with little or no degrade, slight tendency to cup. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to 12% moisture content: radial 1.6%; tangential 4.2%. Movement in service is rated as small.

Working Properties: The timber works fairly easily with hand and machine tools, only slight blunting of cutters; finishes well; good gluing and nailing characteristics; takes a satisfactory finish.

Durability: Not durable to moderately durable in ground contact; not resistant to termite attack; sapwood liable to powder-post beetle attack.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood is rated moderately resistant using either open tank or pressure-vacuum systems.

Uses: Interior joinery, light construction, flooring, plywood, furniture and cabinetwork, general carpentry work, ships' decking.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Farmer, R. H. (ed.).
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3. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of
Philippine woods. The Lumberman 12(5):66+A-H.
4. Lavers, G. M.
1967. The strength properties of timbers. For.
Prod. Res. Bul. No. 50. H. M. Stationery Office.
London.

PENTACE spp.

THITKA

Family: Tiliaceae

Other Common Names: Melunak (Malaya), Takalis (Sabah),
Baru baran (Sarawak), Sisiat (Thailand), Kashit (Burma).

Distribution: Throughout Burma, Malay Peninsula including Indo-China, and North Borneo.

THE TREE Reaches a height of 100 ft, clear boles to 30-35 ft, trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood reddish-brown, golden-brown, or deep red-brown, darkening on exposure; sapwood yellowish, not sharply defined. Texture moderately fine; grain interlocked producing a narrow regular stripe on quartered faces; without characteristic odor or taste but has a sour smell when freshly milled; lustrous.

Weight: Basic specific gravity (ovendry weight/green volume) 0.56; air-dry density 40pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	10,845	1,490	5,790
13%	12,960	1,610	7,295
Green (2)	10,590	1,630	5,130
16%	12,320	1,745	6,330

Janka side hardness 915-1,070 lb for green material and 930-1,305 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to dry slowly with little tendency to checking and warping. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 3.1%; tangential 6.5%; volumetric 10.1%.

Working Properties: Works satisfactorily with hand and machine tools, interlocked grain results in tearing on radial faces when planed; good nailing and gluing and finishes well.

Durability: Reports on durability somewhat variable, liable to termite attack.

Preservation: Resistant to preservative treatments.

Uses: Furniture, millwork, paneling, joinery, flooring, specialty items (instrument boxes, T-squares).

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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1965. The strength properties of Malayan timbers.
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PENTACME CONTORTA

WHITE LAUAN

(Also see *Shorea* spp.)

Family: Dipterocarpaceae

Other Common Names: Bayokan, Lauan-blanco, Tiaong (Philippines).

Distribution: Abundant in primary forests of the Philippines.

THE TREE

A large tree, with a tall cylindrical bole, to a height of 160 ft; with trunk diameters to 6 ft. A rather small twisted tree in Malaya.

THE WOOD

General Characteristics: Heartwood grayish, sometimes with a pinkish tinge; sapwood not distinct. Texture moderately coarse; grain interlocked; luster low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.43; air-dry density 33 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (3)*	7,550	1,380	3,700
12%	11,600	1,690	6,000

Janka side hardness 580 lb for green material and 690 lb for dry. Forest Products Laboratory toughness 284 in.-lb green and 222 in.-lb dry (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: The wood seasons well with little or no degrade. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 4.0%; tangential 7.7%.

Working Properties: Works with some difficulty. Planes and turns well but works poorly in other operations. Rotary peels well, glues satisfactorily.

Durability: Vulnerable to attack by decay fungi and termites.

Preservation: Easy to treat with preservative oils using a pressure-vacuum process; penetration of the preservative is complete but not evenly distributed except in the sapwood.

Uses: Furniture, cabinetmaking, interior finish, flooring, veneer and plywood, particleboard, pulp and paper, construction.

ADDITIONAL READING

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1974. Timbers of the Philippines. Gov. Printing Office, Manila.
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1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.
3. Rocafort, J. E.
1972. The mechanical properties of white lauan [Pentacme contorta (Vid.) Merr. and Rolfe] Forpride Digest 1 (2 and 3):47-48.

PINUS INSULARIS
SYN. P. KESIYA and P. KHASYA

BENGUET PINE

Family: Pinaceae

Other Common Names: Saleng (Philippines), Tinyu, Tinshu (Burma), Dingsa (India).

Distribution: High mountain areas of southeast Asia including Assam and Burma, southern Vietnam, and northern Luzon in the Philippines. A favored plantation species in Zambia, Kenya, and elsewhere.

THE TREE Reaches a height of 100-130 ft with straight, cylindrical boles clear to 40 ft; trunk diameters up to 40-55 in.

THE WOOD General Characteristics: Heartwood yellowish, light reddish-brown, to pale brown, darkening on exposure; sapwood whitish to creamy-white, not distinct. Texture moderately coarse, uneven; grain straight; dull to somewhat lustrous; resinous odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.43-0.50; air-dry density 32-38 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	7,650	1,460	3,520
12%	15,000	2,120	7,400
Green (<u>4</u>)	6,300	1,050	3,330
12%	10,660	1,440	6,070

Janka side hardness 400-540 lb green and 425-785 lb dry. Forest Products Laboratory toughness 260 in.-lb green and 254 in.-lb dry (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little or no degrade.
No data available on kiln schedules. Shrinkage green to ovendry: radial 4.4%; tangential 7.8%.

Working Properties: Easy to work; resin, though, may gum cutters and tools.

Durability: Heartwood not durable in ground contact, readily attacked by termites.

Preservation: Sapwood reported to be permeable, heartwood moderately resistant to impregnation.

Uses: General construction, posts and poles, pulp and paper, fiberboard, veneer and plywood, furniture components, boxes and crates, millwork.

ADDITIONAL READING

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1966. The mechanical and related properties of Philippine woods. *The Lumberman* 12(5):66+A-H.
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1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.
3. Reyes, L. J.
1938. Philippine woods. Commonwealth of the Philippines. Dep. Agric. and Comm. Tec. Bul. No. 7. Manila.
4. Sekhar, A. C., and N. S. Rawat.
1960. A note on mechanical properties of Pinus insularis. *Indian Forester* 86(10):617-620.

PINUS MERKUSII

MERKUS PINE

Family: Pinaceae

Other Common Names: Tinyu, Tinshu (Burma), Tapulau, Mindoro pine (Philippines).

Distribution: Eastern Burma, Indo-China, Sumatra, and Luzon and Mindoro in the Philippines. It is the only member of the genus that has a natural range south of the Equator.

THE TREE Reaches a height of 80-100 ft; bole straight, cylindrical, 40 ft in length; trunk diameter up to about 3 ft.

THE WOOD General Characteristics: Heartwood yellowish- to orange-brown, darkening on exposure; sapwood whitish to creamy-white, sharply delineated in old trees. Texture moderately coarse; grain straight; lustrous when freshly cut but becoming dull with age; resinous odor and a faint resinous taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 43 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)*	8,720	1,850	3,900
12%	18,700	2,480	8,500

Janka side hardness 605 lb for green and 620 lb for dry material. Forest Products Laboratory toughness 290 in.-lb for green and 260 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for reference.

Drying and Shrinkage: Easy to dry with little or no degrade.
No data available on kiln schedules or shrinkage characteristics.

Working Properties: Saws easily and works to a good finish;
resins may gum cutters and tools.

Durability: The wood is rated as nondurable and liable to
termite attack.

Preservation: No data available.

Uses: General construction.

ADDITIONAL READING

1. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of
Philippine woods. *The Lumberman* 12(5):66+A-H.
2. Pearson, R. S., and H. P. Brown.
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Dep. Agric. and Comm. Tec. Bul. No. 7. Manila.

PLANCHONIA spp.

PUTAT PAYA

Family: Lecythidaceae

Other Common Names: Lamog (Philippines).

Distribution: Indo-Malayan region and western Pacific Islands; quite common in seasonally flooded areas of Sabah.

THE TREE A large tree 130-150 ft in height with boles clear to 60-70 ft; trunk diameters 30-50 in. over high buttresses.

THE WOOD General Characteristics: Heartwood light to dark red-brown with darker, almost purplish zones in some material; sapwood paler and sharply defined. Texture moderately fine and even; grain fairly straight to irregular and interlocked; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.59; air-dry density 48 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	9,300	1,240	4,300
13%	13,800	1,540	7,650
Green (1)	9,010	1,630	4,970
12%	15,100	1,900	7,700

Janka side hardness 1,050-1,300 lb for green material and 1,310-1,400 lb for dry. Forest Products Laboratory toughness about 135 in.-lb for both green and dry material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Very difficult to season, prone to checking, warp, and collapse. Suggested to air dry to 25% moisture content, then to kiln dry using schedule T2-C2 for 4/4 stock and T2-C1 for 8/4. Shrinkage green to 12% moisture content: radial 4.5%; tangential 8.0%. Movement in service is rated as medium.

Working Properties: Rather easy to saw and machines well in all operations; predrilling prior to nailing is recommended; takes a fine polish.

Durability: Heartwood decay resistance is reported as variable and likely to be nondurable in service.

Preservation: Based on treatments using a pressure-vacuum system, heartwood is rated as extremely resistant; sapwood permeable.

Uses: Generally used for rough temporary construction work, suggested for flooring and furniture components.

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PODOCARPUS spp.

TOTARA
THITMIN

Family: Podocarpaceae

Other Common Names: Malaalmaiga, Dilang butiki (Philippines), Totara, Miro, Matai (New Zealand), Setada (Malaya), Rempayan (Sabah), Landin (Sarawak), Paya (Thailand), Djamudju (Indonesia), Amunu (Fiji).

Distribution: Indo-Malayan region, New Zealand, New Guinea, Borneo, and extending to the Fiji Islands.

THE TREE Varies with species; reaches a height of 100-180 ft with straight clear boles 50 ft and more; trunk diameters 2-4 ft, sometimes reaching 6 ft.

THE WOOD General Characteristics: Heartwood pinkish-, yellowish-, or orange-brown; sapwood whitish, often not differentiated. Texture fine and even; grain straight; lustrous, sometimes becoming dull with age; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) varies with species 0.33-0.52; air-dry density 25-40 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	6,370	1,220	3,070
12%	9,360	1,380	5,850
Green (<u>4</u>)	8,855	1,340	4,535
14%	10,390	1,515	7,030

Janka side hardness 445-580 lb for green material and 450-860 lb for dry. Forest Products Laboratory toughness 57 in.-lb for green and 46 in.-lb for dry material (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Generally seasons quickly with little or no degrade. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 3.3%; tangential 5.7%; volumetric 10.4%.

Working Properties: Works readily in all hand and machine operations.

Durability: Variable from nondurable to durable.

Preservation: Sapwood treatable; heartwood reported to be resistant.

Uses: Joinery, millwork, tanks and vats, light construction, flooring, veneers, furniture components, general carpentry, carving.

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3. Entrican, A. R., revised by J. S. Reid.
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1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1. Indian For. Rec. 18(10):1-70.

POMETIA SPP.

KASA I

Family: Sapindaceae

Other Common Names: Malugai (Philippines), Taun (New Guinea), Truong (Indo-China), Sibu (Sarawak).

Distribution: Malaysia, Indo-China, Indonesia, Philippines, and other western Pacific islands. Widespread and abundant in coastal areas and foothills.

THE TREE Reaches a height of 100-150 ft, boles to 70 ft, often irregular; trunk diameters 30-40 in. above high plank buttresses.

THE WOOD General Characteristics: Heartwood light to dark red-brown, usually with a dull purple-red cast; sapwood rather lighter in color but not always sharply defined; texture moderately coarse; grain straight to interlocked, sometimes wavy; luster usually low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.54; air-dry density 41pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (<u>4</u>)* 17%	-- --	-- --	5,365 7,158
Green (<u>3</u>) 12%	8,100 13,700	1,360 1,790	3,900 7,250
Green (<u>1</u>) 12%	9,650 15,400	1,620 2,080	4,560 8,670

Janka side hardness 1,300-1,890 lb for dry material;
Forest Products Laboratory toughness 255 in.-lb
for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to require particular care in drying as the timber is liable to warp due to excessive shrinkage; some collapse may also occur. No data available on kiln schedules. Shrinkage green to oven-dry: radial 5.5%; tangential 6.8%; volumetric 13.2%.

Working Properties: Easy to work and takes a fine finish; reported to be good stock for steam bending.

Durability: Heartwood moderately durable when exposed or in ground contact; only moderately resistant to termite attack.

Preservation: Heartwood absorbs about 4-7pcf of preservative oils using a pressure-vacuum system.

Uses: Furniture components, flooring, joinery, general carpentry work, tight cooperage, tool handles, light construction, veneer and plywood, bent-work, boatbuilding.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
1966. The mechanical properties of 81 New Guinea timbers.
Div. For. Prod. Technol. Pap. For. Prod. Aust. No. 41.
2. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
3. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
4. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers.
Malayan Forester 23(4):307-319.

PSEUDOSINDORA PALUSTRIS
and SINDORA spp.

SEPETIR

Family: Leguminosae

Other Common Names: Sindur (Indonesia), Supa, Kayu Galu (Philippines), Makata (Thailand), Gu (Indo-China).

Distribution: Malaysia, Indo-China, and the Philippines; usually found in the lowlands, locally common.

THE TREE Reaches a height of 100-150 ft, straight cylindrical boles; trunk diameters 2-4 ft, free of buttresses.

THE WOOD General Characteristics: Heartwood brown with a pink or golden tinge, darkening on exposure, dark brown or black streaks sometimes present in species of Sindora; sapwood light gray-brown or straw colored, sometimes with pink tinge, usually clearly defined. Texture moderately fine and even; grain straight or shallowly interlocked; without luster; characteristic spicy smell that persists when dry; wood has an oily feel.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52-0.58; air-dry density 40-45 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	10,300	1,695	5,285
17%	13,330	1,980	6,725
Green (3)	11,700	1,470	5,690
12%	18,100	1,840	9,250

Janka side hardness 930-950 lb for green material and 1,170-1,410 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well, but rather slowly, with little warp, tendency to end-splitting. Kiln schedule T8-B3 is suggested for 4/4 stock and T5-B1 for 8/4. Shrinkage green to ovendry: radial 3.7%; tangential 7.0%; volumetric 10.5%. Movement in service is rated as small.

Working Properties: Gum tends to accumulate on the teeth of saws, planes cleanly, rather rapid dulling of cutters, tends to char in boring, difficult to work with handtools, finishes well.

Durability: Rated as nondurable in ground contact under Malayan exposure and not resistant to subterranean or dry wood termite attack. Sapwood readily attacked by powder-post beetles.

Preservation: Heartwood rated as extremely resistant to preservative treatments; sapwood moderately resistant.

Uses: General carpentry, furniture and cabinetwork, joinery, flooring, plywood, decorative veneers.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
3. Lavers, G. M.
1967. The strength properties of timbers. For. Prod.
Res. Bul. No. 50. H. M. Stationery Office. London.
4. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers.
Malayan Forester 28(4):307-319.

PTEROCARPUS DALBERGIOIDES

ANDAMAN PADAUK

Family: Leguminosae

Other Common Names: Andaman redwood, Vermillion wood (U.S.A.).

Distribution: Found only in the Andaman Islands; growing in deciduous and semimoist deciduous forests, usually on or near riverbanks.

THE TREE Reaches a height of 80-120 ft, boles straight and cylindrical, clear to 40 ft; trunk diameters 2-4 ft above the buttresses.

THE WOOD General Characteristics: Heartwood variable, mainly a rich crimson hue or shades of red to brown, often with darker red or blackish streaks, sometimes pale red or yellowish; sapwood grayish and narrow. Texture rather coarse; grain generally interlocked; dull to lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.63; air-dry weight 48pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>3</u>)*	12,160	1,600	6,825
8%	15,210	1,780	9,160

Janka side hardness 1,270 lb for green and 1,630 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber dries well, little degrade results if standing trees are girdled and allowed to dry on the stump. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.3%; tangential 4.4%; volumetric 6.4%.

working Properties: Not difficult to saw and machine but because of interlocked grain does not dress to a smooth finish, turns well, takes a good polish.

Durability: The heartwood is rated as very durable and also resistant to termite attack.

Preservation: Heartwood is reported to be moderately resistant to preservative treatments; sapwood probably permeable.

Uses: Joinery, flooring, furniture, decorative veneers, paneling, parquet, cabinetwork.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Hart, G.
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Assoc. London.
3. Limaye, V. D.
1933. The physical and mechanical properties of woods
grown in India. Third Interim Rpt. on Proj. 1. Indian
For. Rec. 18(10):1-70.
4. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India
Central Publ. Br., Calcutta.

PTEROCARPUS INDICUS

NARRA

Family: Leguminosae

Other Common Names: Angsana (Sabah), Sena (Malaya), Amboyna (a name for highly figured veneers cut from burls).

Distribution: Philippines, Borneo, Burma, New Guinea, and the Malay Archipelago. Often planted for shade along roadsides and as an ornamental.

THE TREE May reach a height of 100 ft or more, usually of poor form with a large crown; trunk diameters up to about 3 ft above high wide-spreading buttresses.

THE WOOD General Characteristics: Heartwood light yellow, golden-brown, reddish-brown, to a distinct red; sapwood whitish or pale straw, clearly defined. Texture moderately fine to moderately coarse and uneven due to the ring-porous structure; grain interlocked and sometimes wavy, together with dark growth bands produce an attractive figure; somewhat lustrous; has a fragrant odor which persists even when dry.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	10,700	1,470	5,570
12%	13,800	1,770	8,450
Green (<u>4</u>)	10,100	1,480	5,150
12%	14,200	1,700	7,900

Janka side hardness 945-1,080 lb for green material and 1,055-1,350 lb for dry. Forest Products Laboratory toughness 300 in.-lb for green and 234 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Easy to season with very little or no degrade. No data on kiln schedules available. Shrinkage green to ovendry: radial 2.8%; tangential 4.0%. Movement in service is rated as small.

Working Properties: Easy to work with both hand and machine tools; turns well, and takes a good finish.

Durability: Generally, heartwood is reported to be very durable. Some experience in Malaya is conflicting.

Preservation: Reported as likely to be resistant to impregnation.

Uses: A valued furniture and cabinet wood, decorative veneers, novelty items, interior trim.

ADDITIONAL READING

1. Bolza, E., and N. H. Kloot.
1966. The mechanical properties of 81 New Guinea timbers.
Div. For. Prod. Technol. Pap. For. Prod. Aust. No. 41.
2. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
3. Hart, G.
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4. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.

PTEROCARPUS MACROCARPUS

BURMA PADAUK

Family: Leguminosae

Other Common Names: Mai Pradoo, Pradoo (Thailand).

Distribution: Sometimes rather common in the upper mixed and dry forests of Burma; also found in mixed deciduous forests of Thailand.

THE TREE A medium-sized tree, up to 80 ft in height, boles clear to 25 ft straight and cylindrical, sometimes irregular; trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood bright yellowish-red to dark brick-red, streaked with darker lines, lustrous when freshly cut but becoming a dull but attractive golden brown on exposure; sapwood grayish, narrow. Texture moderately coarse; grain interlocked; has a faint spicy odor.

Weight: Basic specific gravity (ovendry weight/green volume) 0.75; air-dry density 54pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	15,975	1,900	8,200
12%	20,640	2,080	10,945

Janka side hardness 2,040 lb for green material and 2,170 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons well with little degrade, but does have a slight tendency to surface check. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.4%; tangential 5.8%; volumetric 8.4%.

Working Properties: Rather difficult to saw, especially when dry and also difficult to work with handtools, turns well, dresses to a smooth finish, glues satisfactorily.

Durability: The heartwood is rated as very durable and also resistant to termite attack. Sapwood liable to attack by powder-post beetles.

Preservation: Heartwood extremely resistant to preservation treatments.

Uses: Decorative flooring, furniture, cabinetwork, tool handles, billiard tables.

ADDITIONAL READING

1. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
London.
2. Hart, G.
1955. Timbers of southeast Asia. Timber Development
Assoc. London.
3. Limaye, V. D.
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grown in India. Third interim rpt. on Proj. 1. Indian
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4. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India
Central Publ. Br., Calcutta.

SANTALUM ALBUM

SANDALWOOD

Family: Santalaceae

Other Common Names: None.

Distribution: Native to the southern regions of India, growing best on dry, stony, but fertile soils. Other species widely scattered from the Malay Archipelago to Australia and the Pacific Islands including Hawaii.

THE TREE A small tree up to about 25-40 ft in height, with trunk diameters usually 4 to 6 in.

THE WOOD General Characteristics: Heartwood light yellowish-brown when freshly cut, turning dark brown on exposure, and with further aging, to a dark reddish-brown; sapwood whitish. Texture very fine and even; grain straight, sometimes wavy; dull to somewhat lustrous, with oily feel; heartwood with a strong fragrant scent that persists, without characteristic taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.75; air-dry density 53pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>1</u>)*	12,300	--	5,300
14%	15,600	--	7,500

Janka side hardness 1,520 lb for green material and 1,680 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons with little or no degrade, but slowly. No information available on kiln schedules or shrinkage values.

Working Properties: Saws without difficulty and works to a smooth satin-like finish, an excellent carving wood, turns well.

Durability: The heartwood is rated as extremely durable.

Preservation: Sapwood is reported as treatable using the boric acid diffusion process.

Uses: Fine furniture, carvings, turnery, specialty items. Oils extracted from the heartwood are in high demand for incense, perfumery, medicines, scenting clothing, etc.

ADDITIONAL READING

1. Jain, J. C., and P. S. Rao.
1966. Industrial utilization of sandal sapwood. Indian Forester 92(1):16-18.
2. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

SCHIMA spp.

NEEDLEWOOD

Family: Theaceae

Other Common Names: Laukya (Burma), Chilauni (India), Mang-tan (Thailand), Medang Gatal (Malaysia), Chinese guger tree (Taiwan).

Distribution: Various species range from the Indo-Malayan region to Indonesia and northward to the Philippines, China, and Taiwan; common in mountain areas.

THE TREE May reach a height of 100 ft. bole straight and cylindrical; trunk diameter 24-30 in. Species in China up to 130 ft in height with diameters of 60 in.

THE WOOD General Characteristics: Heartwood light red, reddish-brown or yellowish-brown, sometimes with darker bands; sapwood whitish but gradually merging into heartwood. Texture moderately fine and even; grain straight to interlocked and irregular; luster low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.54; air-dry density 43 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	7,900 14,300	1,360 1,970	3,780 7,645

Janka side hardness 775 lb for green material and 1,245 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Generally reported to be liable to excessive degrade due to warping and checking; some work in India, however, indicated good drying characteristics. No data available on kiln schedules. Shrinkage green to ovendry: radial 4.5%; tangential 8.5%; volumetric 20.1% (unusually high value).

Working Properties: Saws easily, works to a smooth finish, and takes a fine polish. Bark contains needle-like crystals that may be an irritant in working.

Durability: Heartwood not durable when exposed or in ground contact.

Preservation: Heartwood difficult to treat; sapwood is permeable.

Uses: Joinery, flooring, furniture components, millwork, construction work (under cover).

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15. 2 vol.
3. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1. Indian For. Rec. 18(10):1-70.
4. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

SCORODOCARPUS BORNEENSIS

KULIM

Family: Olacaceae

Other Common Names: Bawang Hutan (Sabah, Sarawak).

Distribution: Sumatra, Malay Peninsula, and Borneo; throughout lowland forests, occasionally gregarious.

THE TREE May reach a height of 125 ft with clear boles to 70 ft, trunk diameters about 24 in., sometimes to 60 in.

THE WOOD General Characteristics: Heartwood dark red-brown to purple-brown; sapwood light yellow, sometimes with a transitional red-brown zone. Texture moderately fine; grain shallowly to deeply interlocked; luster low; a strong smell of garlic when freshly cut; vessel lines may give a silver fleck on longitudinal surfaces.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 54pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,240	1,930	6,440
16%	15,500	2,160	8,270

Janka side hardness 1,290 lb for green material and 1,370 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber dries fairly rapidly, large radial splits may develop. No data available for kiln schedules. Shrinkage green to oven dry: radial 4.1%; tangential 9.3%; volumetric 13.3%.

Working Properties: Moderately easy to saw; dresses and bores smoothly, if grain not deeply interlocked.

Durability: Reported to be moderately durable with some resistance to termite attack. Some exposure tests indicate a life of about 2 to 5 years when placed in waters containing marine borers.

Preservation: Absorptions of 4 to 7 pcf of preservative oils are reported for full-cell pressure treatments. Sapwood is more readily treated.

Uses: Heavy and light construction work where decay hazards are low.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan For. Rec. 15.
3. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers. Malayan Forester 28(4):307-319.

SHOREA spp.

BALAU GROUP

Family: Dipterocarpaceae

Other Common Names: Red Selangan Batu (Sabah), Guijo (Philippines), Balau Merah, Membatu (Malaya), Balau Merah (Indonesia).

Distribution: Malay Peninsula including Indochina, Indonesia, Philippines; often in almost pure stands.

THE TREE Reaches a height of 200 ft, boles straight and regular; trunk diameters to 6 ft over large buttresses.

THE WOOD General Characteristics: Heartwood light to deep red-brown; sapwood lighter in color, not always sharply demarcated. Texture moderately fine to slightly coarse; grain typically interlocked; without characteristic odor or taste; rather dull; resin canals with white contents in concentric lines on end surfaces.

Weight: Basic specific gravity (ovendry weight/green volume) about 0.70; air-dry density 53 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard, second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	15,350	2,040	7,710
14%	20,670	2,170	10,050
Green (2)	11,400	2,060	5,300
12%	18,400	2,560	10,000

Janka side hardness 1,230-1,420 lb for green material and 1,480-1,640 lb for dry. Forest Products Laboratory toughness 430 in.-lb for green and 490 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Rather difficult to season, dries slowly, liable to end splitting, warping is variable. Kiln schedule T8-B3 is suggested for 4/4 stock and T5-B1 for 8/4. Shrinkage green to ovendry: radial 6.2%; tangential 11.4%. Movement in service is rated as medium.

Working Properties: Rather difficult to machine because of high density, saws cleanly, dresses to a smooth finish, some tearing of interlocked grain, only moderate blunting of cutters, wood should be prebored for nailing.

Durability: Heartwood durability very variable and should be classified as nondurable. Sapwood is very susceptible to attack by powder-post beetle.

Preservation: Heartwood is extremely resistant to preservative treatments; sapwood is classified as permeable.

Uses: Heavy construction, framing of boats, parquet flooring, heavy-duty flooring, utility furniture.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
3. U.K.: F.P.R.L.
1965. Report on a consignment of Selangan Batu Merah (Shorea guiso (Blanco) Bl.). Consignment No. 1272. For. Prod. Res. Lab., Princes Risborough.

SHOREA SPP.

DARK RED MERANTI -RED LAUAN GROUP Family: Dipterocarpaceae

Other Common Names: Red lauan, Tangile (Philippines), Dark red seraya, Obar suluk (Sabah), Saya (Thailand), Meranti ketuko (Indonesia), Nemesu (Malaya), Alan (Sarawak).

Distribution: Malaysia, Indonesia, and the Philippines.

THE TREE A large tree reaching a height of 200 ft and more with a straight cylindrical bole; trunk diameters 5 to 6 ft over moderately large and high buttresses.

THE WOOD General Characteristics: Heartwood dark brown, medium to deep red, sometimes with a purplish tinge, commonly with white dammar or resin streaks; sapwood pinkish, rather poorly defined. Texture rather coarse; grain interlocked, sometimes straight; luster low, without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) averages about 0.55; air-dry density 42 pcf. In Sabah, this grouping of Shorea requires an air-dry weight over 40 pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second and third sets on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	9,900	1,400	4,920
12%	13,300	1,650	7,670
Green (<u>4</u>)	8,420	1,640	4,350
17%	11,130	1,750	5,740
Green (<u>3</u>)	7,800	1,430	3,880
12%	11,500	1,690	6,000

Janka side hardness 780-825 lb air dry. Forest Products Laboratory toughness 292 in.-lb green (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Moderately slow drying with a tendency to warp, thick material may check and end split. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.8%; tangential 7.9%; volumetric 13.3%. Movement in service is rated as small.

Working Properties: Easy to work with hand and machine tools, dresses to a smooth finish, some tearing of interlocked grain; good gluing and nailing properties; takes a good finish.

Durability: Heartwood is rated as only moderately durable and should not be used in high hazard areas; sapwood liable to attack by powder-post beetles. Not resistant to marine borers.

Preservation: Generally rated as resistant to preservative treatments; sapwood reported to be moderately resistant to permeable, varying with species.

Uses: Veneer and plywood, joinery, flooring, furniture and cabinetwork, general construction, boatbuilding.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
2. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office.
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Malayan Forester 28(4):307-319.
5. Meniado, J. A., R. R. Valbuena, and F. N. Tamolang.
1974. Timbers of the Philippines. Gov. Printing Office,
Manila.

SHOREA spp.

LIGHT RED MERANTI-LIGHT RED
LAUAN GROUP

Family: Dipterocarpaceae

Other Common Names: Saya (Thailand), Red Seraya (Sabah), Meranti Merah (Indonesia), White Lauan (S. almon and some species of Parashorea and Pentacme), Almon, Mayapis (Philippines).

Distribution: Malay Peninsula, Indonesia, the Philippines, as well as Sabah and Sarawak, usually at low altitudes on well-drained soils.

THE TREE A large tree reaching a height of 150-200 ft, well-shaped boles clear to 90 ft and more; trunk diameters 3 to 6 ft; sometimes buttressed.

THE WOOD General Characteristics: Heartwood variable from almost white to pale pink to dark red, or pale brown to deep brown; sapwood lighter usually with a grayish tinge, distinct. Grain usually interlocked, sometimes somewhat straight; texture coarse; slightly lustrous; usually without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) sorted to range from 0.33-0.52, averaging about 0.40; air-dry density 25-40 pcf, averaging 32.

Mechanical Properties: (First two sets of data based on the 2-in. standard; the third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 12%	7,350 11,100	1,340 1,630	3,720 5,500
Green (5) 14%	7,710 10,830	1,650 1,970	4,200 6,000
Green (4) 12%	9,150 12,750	1,400 1,520	4,600 7,250

Janka side hardness 570-665 lb for dry material. Forest Products Laboratory toughness 270 in.-lb for green and 216 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little or no degrade; there is, though, a tendency to warp, particularly in thin stock. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 4.6%; tangential 8.5%; volumetric 14.3%. Movement in service is rated as small.

Working Properties: Easy to work with both hand and machine tools; nailing and gluing are satisfactory; takes a good finish, resin and oil exudation is not a problem.

Durability: Heartwood generally rated as nondurable in ground contact and is susceptible to dry-wood and subterranean termite attack; sapwood liable to powder-post beetle attack.

Preservation: Heartwood varies from resistant to very resistant to preservative treatments; sapwood usually moderately resistant.

Uses: Light structural work, furniture components, joinery, plywood, cabinetwork, flooring, concrete form work, a general utility wood.

ADDITIONAL READING

1. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
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5. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers.
Malayan Forester 28(4):307-319.

SHOREA spp.

WHITE MERANTI GROUP

Family: Dipterocarpaceae

Other Common Names: Melapi (Sabah, Sarawak), Meranti Puteh (Indonesia), Pa-nong (Thailand), Bo-Bo (Vietnam), Makai (India), Manggasinoro (Philippines).

Distribution: Widely distributed from India in the north and west through the Malayan Peninsula to the Philippines and Celebes to the east.

THE TREE About 150-200 ft in height with straight clear boles 70-100 ft in length; trunk diameters 3-5 ft above large buttresses.

THE WOOD General Characteristics: Heartwood whitish when freshly cut, becoming light yellow-brown on exposure; sapwood about 2 to 2-1/2 in. wide, poorly defined. Texture moderately coarse and even; grain interlocked; slightly lustrous; dried material without characteristic odor or taste. Silica is abundant in the ray tissue.

Weight: Basic specific gravity (ovendry weight/green volume) variable with species but generally 0.40-0.55; air-dry density 30 to 42 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength Psi	Modulus of elasticity 1,000 psi	Maximum crushing strength Psi
Green (<u>4</u>)* 14%	9,190 --	1,840 --	4,900 6,420
Green (<u>4</u>) 15%	9,753 12,415	1,305 1,490	5,490 6,350

Janka side hardness 870-1,150 lb for dry material.

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little degrade, some cupping and stain may occur; dries rapidly. Kiln schedule T6-D4 is suggested for 4/4 stock and T3-D3 for 8/4. Shrinkage green to ovendry: radial 3.0%; tangential 6.6%; volumetric 7.7%.

Working Properties: Very difficult to saw or machine due to rapid dulling of cutters caused by high silica content; stellite-tipped or carbide-tipped tools are suggested; sawn surfaces tend to be wooly.

Durability: Not durable in ground contact and vulnerable to dry-wood and subterranean termite attack. Though silica content is high, there is no immunity to marine borer attack.

Preservation: Heartwood moderately difficult to treat using pressure-vacuum treatments, absorptions of 6 to 7 pcf of preservative oils are noted. Also reported to be extremely resistant to impregnation.

Uses: Veneer and plywood, flooring, general construction, vats and casks, boat framing.

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4. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers. Malayan Forester 28(4):307-319.

SHOREA SPP.

YELLOW MERANTI GROUP

Family: Dipterocarpaceae

Other Common Names: Yellow Seraya, Seraya Kuning (Sabah),
Meranti Damar Hitam (Malaya), Meranti Kuning (Indonesia).

Distribution: Malaysia, Indonesia, and the Philippines.

THE TREE Reaches a height of 225 ft, boles straight and cylindrical;
trunk diameters to 5 ft over large buttresses.

THE WOOD General Characteristics: Heartwood light yellow or yellow-brown,
sometimes with a greenish tinge, darkening on exposure;
sapwood paler in color, often with a grayish tinge. Texture
moderately coarse; grain shallowly interlocked; luster
low, dry material without characteristic odor or taste;
liable to discolor if in contact with iron under moist conditions.

Weight: Basic specific gravity (ovendry weight/green volume)
variable mostly between 0.40-0.52; air-dry density 30-40 pcf.

Mechanical Properties: (First set of data based on the 2-cm
standard; second set on the 2-in. standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)* 12%	9,600 12,800	1,400 1,450	4,650 7,350
Green (4)	7,940	1,520	4,280

Janka side hardness 585-760 lb for green material.

*See "Additional Reading" for references.

Drying and Shrinkage: Thin material seasons rather slowly with a tendency to cup; thicker material prone to honeycomb. Kiln schedule T10-D5S is suggested for 4/4 stock and T8-D4S for 8/4. Shrinkage green to ovendry: radial 3.4%; tangential 8.0%; volumetric 10.4%. Movement in service rated as small.

Working Properties: Works easily with hand and machine tools and dresses to a smooth finish, some tearing of interlocked grain; good gluing and nailing characteristics; suitable for steam bending to a moderate radius of curvature.

Durability: Heartwood not durable in exposed conditions or in ground contact, liable to termite attack. Sapwood susceptible to powder-post beetle attack. Not resistant to marine borers.

Preservation: Heartwood extremely resistant to preservative treatments; sapwood rated as moderately resistant.

Uses: Joinery, flooring, furniture components, plywood, paneling, light structural work. Dammar exudates are collected from trees in Malaya.

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3. Lavers, G. M.
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London.
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1965. The strength properties of Malayan timbers.
Malayan Forester 28(4):307-319.

SONNERATIA SPP.

PEREPAT

Family: Sonneratiaceae

Other Common Names: Berembang, Gedabu (Malaya), Pagatpat (Philippines), Tabyu, Kambalu, Labe (Burma), Kandal (India).

Distribution: Throughout the Indo-Malayan region, inhabiting mangrove swamps along seacoasts and tidal streams.

THE TREE Mostly reaching a height of 50 ft with trunk diameters of 2 to 3 ft in India; but up to 80-120 ft in height in Malaya and the Philippines; boles frequently short and crooked.

THE WOOD General Characteristics: Heartwood pale gray, gray-brown, light brown to dark chocolate-brown; sapwood grayish, not always sharply differentiated. Texture fine and even; grain straight to slightly interlocked; dull to somewhat lustrous; generally without characteristic odor or taste, S. caseolaris has a salty taste and a fishy smell when freshly cut.

Weight: Basic specific gravity (ovendry weight/green volume) variable 0.40-0.65; air-dry density 30-50 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 9.5%	9,120 10,415	1,230 1,275	4,215 6,455
Green (<u>4</u>)	10,600	1,520	4,750

Janka side hardness 1,015-1,140 lb for green material.

*See "Additional Reading" for references.

Drying and Shrinkage: Generally reported to season well with little warping or checking. No data available on kiln schedules. Shrinkage green to ovendry: radial 2.4%; tangential 6.2%; volumetric 10.0%.

Working Properties: S. caseolaris is easy to work and takes a fine polish; S. apetala reported to be easy to saw but difficult to work to a smooth finish. Corrodes iron fastenings.

Durability: Generally classified as moderately durable but vulnerable to termite attack; may possess some resistance to marine borers.

Preservation: No information available.

Uses: Light construction, utility furniture, boxes and crates, flooring.

ADDITIONAL READING

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SWINTONIA SPP.

MERPAUH

Family: Anacardiaceae

Other Common Names: Selan (Sarawak), Boilam (India),
Taung-thayet (Burma), Khan thong (Thailand).

Distribution: Burma and the Malayan Peninsula eastward into
Borneo, Cambodia, and the Philippines.

THE TREE A large tree with clear boles to 80 ft; trunk diameters
3-4 ft; base of stems often fluted with high buttresses.

THE WOOD General Characteristics: Heartwood grayish-white, yellow-brown,
light red-brown, narrow lighter-colored striping often on
radial faces and dark zigzag figure on tangential faces;
sapwood not clearly differentiated. Texture moderately
coarse; grain straight to interlocked; lustrous when
freshly cut; without characteristic odor or taste. Some
species are siliceous.

Weight: Basic specific gravity (ovendry weight/green volume)
0.61; air-dry density 46 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (3)*	11,520	2,115	5,710
18%	14,750	2,310	7,110
Green (4)	8,625	1,640	4,095
14%	11,435	1,850	5,590

Janka side hardness 740-1,070 lb for green material
and 850-1,300 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Air seasons fairly rapidly, only slight bowing and twisting, some end-checking; prone to staining. No information available on kiln schedules. Shrinkage green to ovendry: radial 3.2%; tangential 6.0%; volumetric 10.8%.

Working Properties: Tension wood is rather common causing difficulty in sawing and a woolly finish, otherwise works rather well.

Durability: Heartwood is not durable and sapwood is particularly prone to stain.

Preservation: Heartwood reported to be treatable with absorption of 7-17pcf of preservative oils using an open-tank system.

Uses: Boatbuilding, light construction, packing cases, rotary veneer, matches.

ADDITIONAL READING

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Malayan Forester 28(1):56-62.
4. Limaye, V. D.
1933. The physical and mechanical properties of woods grown in India. Third interim rpt. on Proj. 1.
Indian For. Rec. 18(10):1-70.
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SYNCARPIA GLOMULIFERA
SYN. S. LAURIFOLIA

TURPENTINE

Family: Myrtaceae

Other Common Names: Luster (Australia).

Distribution: Blue Mountains and the coastal districts of Queensland and New South Wales (Australia).

THE TREE Reaches a height of 180 ft with a clear bole, trunk diameters 3 ft and more.

THE WOOD General Characteristics: Heartwood red or reddish-brown, sapwood pale pinkish, sharply differentiated. Texture fine to medium; lustrous; grain straight, interlocked, or wavy.

Weight: Basic specific gravity (ovendry weight/green volume) 0.70; air-dry density 60 pcf.

Mechanical Properties: (First set of data based on the 2-in. standard; second set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)* 12%	11,500 19,700	1,730 2,230	6,240 11,400
Green (3) 12%	11,200 23,500	1,540 2,260	5,950 11,900

Janka side hardness 1,370-1,495 lb for green material and 2,600-2,900 lb for dry. Forest Products Laboratory toughness 164 in.-lb for green wood and 130 in.-lb for dry (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Difficult to season, prone to warping; flat-sawn material likely to develop surface checks; liable to collapse; should be air dried prior to kiln drying. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to air-dry: radial 5.7%; tangential 10.4%; volumetric 16.7% (before reconditioning).

Working Properties: Difficult to work with hand tools because of the high density; dulling of saw teeth and planer knives; turns well and takes a good polish.

Durability: Classified as very durable with high resistance to attack by decay fungi and termites; outstanding resistance to marine borers.

Preservation: No information available.

Uses: Marine work, shipbuilding, railway crossties, wharf decking, piling and poles, heavy construction, mallets, bearings, bushings.

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TECTONA GRANDIS

TEAK

Family: Verbenaceae

Other Common Names: Kyun (Burma), Teck (French), Teca (Spanish).

Distribution: Native to India, Burma, Thailand, Indo-China, including Indonesia, particularly Java. Extensively cultivated in plantations within its natural range as well as in tropical areas of Africa and Latin America.

THE TREE On favorable sites, may reach 130-150 ft in height with clear boles to 80-90 ft; trunk diameters usually 3-5 ft; older trees fluted and buttressed.

THE WOOD General Characteristics: Heartwood dark golden-yellow, turning a dark brown with exposure, often very variable in color when freshly machined showing blotches and streaks of various shades; sapwood pale yellowish, sharply demarcated. Grain straight, sometimes wavy; texture coarse, uneven (ring-porous); dull with an oily feel; scented when freshly cut. Dust may cause skin irritations. Silica content variable, up to 1.4% is reported.

Weight: Basic specific gravity (ovendry weight/green volume) 0.55; air-dry density 40pcf.

Mechanical Properties: (First set of data based on the 2-cm standard; second and third sets on the 2-in. standard; third set plantation-grown in Honduras.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (1)* 11%	12,200 15,400	1,280 1,450	6,210 8,760
Green (2) 14%	10,770 12,300	1,570 1,710	5,470 6,830
Green (5) 13%	9,940 13,310	1,350 1,390	4,780 6,770

Janka side hardness 1,000-1,155 lb for dry material. Forest Products Laboratory toughness 116 in.-lb average for green and dry wood (5/8-in. specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons slowly but with little or no degrade, large variations in drying rates reported. Kiln schedule T10-D4S is suggested for 4/4 stock and T8-D3S for 8/4. Shrinkage green to ovendry: radial 2.5%; tangential 5.8%; volumetric 7.0%. Movement in service is rated as small. High resistance to water absorption.

Working Properties: Easily worked with both hand and machine tools and dresses to a very smooth finish if tools are kept sharp; glues moderately well despite its oily nature. Blunting of cutters can be rather severe. As noted, may cause dermatitis in some individuals.

Durability: Heartwood is rated as very durable with respect to decay fungi and termites; not immune to marine borers.

Preservation: Heartwood extremely resistant to preservative treatments, sapwood also of low permeability.

Uses: Shipbuilding, joinery, furniture, flooring, carving, cabinetwork, paneling, turnery, tanks and vats, fixtures requiring high resistance to acids.

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TERMINALIA BIALATA

WHITE CHUGLAM

Family: Combretaceae

Other Common Names: Indian Silver Greywood (Indian name for darker, usually figured wood).

Distribution: Andaman Islands.

THE TREE Reaches a height of 100-160 ft with trunk diameters to 5 ft.

THE WOOD General Characteristics: Bright chrome yellow aging to grayish-yellow, sometimes light nut-brown, olive-brown, or yellow-brown with irregular dark streaks; sapwood often very wide and not differentiated. Grain generally straight; texture medium to coarse; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.58; air-dry density 43 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	11,050	1,760	5,585
13%	13,525	2,010	6,810

Janka side hardness 995 lb for green material and 1,190 lb for dry.

*See "Additional Reading" for reference.

Drying and Shrinkage: Seasons easily with little or no degrade, air drying under cover is suggested. Kiln schedule T6-D2 is used for 4/4 stock and T3-D1 for 8/4. Shrinkage green to ovendry: radial 5.4%; tangential 7.4%; volumetric 13.2%. Veneers split excessively during drying.

Working Properties: Easy to saw and machine and to work with hand tools; dresses to a smooth finish; nailing and gluing are satisfactory.

Durability: Classified as moderately durable but is susceptible to pinhole borer and powder-post beetle attack.

Preservation: Reported to be moderately to extremely resistant to preservative treatments.

Uses: Furniture, cabinetwork, paneling, flooring, ships' fittings.

ADDITIONAL READING

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TERMINALIA CATAPPA

INDIAN ALMOND WOOD

Family: Combretaceae

Other Common Names: Ketapang (Malaya), Talisai (Sabah, Philippines), Badam (Andaman Islands).

Distribution: Indo-Malayan region extending to the Philippines, common in coastal areas; widely planted as an ornamental throughout the tropics, often becoming naturalized.

THE TREE Bole 40-60 ft, buttressed and slightly fluted; trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood brick red to reddish-brown, often marked with darker stripes; sapwood lighter, poorly defined. Texture medium to somewhat coarse; grain interlocked and irregular; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.45-0.58; air-dry density 35-45pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Reported to season rapidly with a moderate amount of warping and little or no checking (Puerto Rico); somewhat more refractory in India. No information on kiln schedule available. Shrinkage green to ovendry: radial 4.5%; tangential 5.7%; volumetric 10.3%.

Working Properties: Saws and machines easily but torn and fuzzy grain is common in planing, shaping, and turning. Sands to a fairly good surface.

Durability: Heartwood is classified as perishable and is very susceptible to dry-wood termite attack.

Preservation: Sapwood absorption of about 9pcf of preservative oils is obtained using an open-tank treatment.

Uses: Furniture and cabinetwork, general light construction, flooring, decorative veneer. The tree produces an edible seed.

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4. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

TERMINALIA PROCERA

WHITE BOMBAY

Family: Combretaceae

Other Common Names: Badam (India).

Distribution: Andaman Islands.

THE TREE A tall tree with long straight boles often clear to 40 ft, trunk diameters 2-3 ft.

THE WOOD General Characteristics: Heartwood light brown to dark grayish-brown; sapwood grayish, often blotched with yellow that yields a water-soluble dye. Grain generally straight; texture coarse; somewhat lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.52; air-dry density 40pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)*	8,400	1,280	4,125
8%	12,455	1,550	7,230

Janka side hardness 955 lb green and 1,070 lb for dry material.

*See "Additional Reading" for reference.

Drying and Shrinkage: Reported to season fairly well but thin stock has a tendency to warp. Kiln schedule T6-D2 is suggested for 4/4 stock and T3-D1 for 8/4. Shrinkage green to oven-dry: radial 3.5%; tangential 6.1%; volumetric 11.1%. Movement in service is rated as small.

Working Properties: The wood is easy to work with hand and machine tools, dresses to a smooth finish and takes a fair polish.

Durability: Heartwood is nondurable and not resistant to termite attack; sapwood is liable to powder-post beetle attack.

Preservation: Reported to be moderately resistant to preservative treatments.

Uses: Furniture, joinery, general carpentry, core stock for plywood.

ADDITIONAL READING

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1972. Handbook of hardwoods. H. M. Stationery Office.
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2. Limaye, V. D.
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1932. Commercial timbers of India. Gov. of India
Central Publ. Br., Calcutta.

TERMINALIA TOMENTOSA COMPLEX

INDIAN LAUREL

Family: Combretaceae

Other Common Names: Taukkyan (Burma), Sadar, Matti, Asan, Marda (India).

Distribution: Widely distributed in India and Burma.

THE TREE May reach a height of 100 ft and more; with clear, straight boles to 70 ft; trunk diameters about 3 ft.

THE WOOD General Characteristics: Heartwood varying from light brown with few markings to dark brown or brownish-black and figured with darker streaks; sapwood reddish-white, sharply differentiated. Grain fairly straight; texture coarse; dull to somewhat lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.73; air-dry density 54pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (2)* 13%	11,290 15,380	1,660 1,910	5,590 8,275
Green (2) 9%	10,710 12,870	1,500 1,680	5,360 7,910

Janka side hardness 1,505-1,850 lb for green material and 2,100-2,340 lb for dry.

*See "Additional Reading" for references.

Drying and Shrinkage: Should be dried slowly. Difficult to dry, especially in large dimensions, liable to checking, warp, and end splitting. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 4.8%; tangential 7.4%; volumetric 13.2%.

Working Properties: Rather difficult to work with hand tools if grain is irregular, machines well, a good turnery wood, reported to be difficult to glue and nail.

Durability: Only moderately durable, sapwood liable to powder-post beetle attack.

Preservation: Absorptions of 3-4 pcf of preservative oils are reported using an open-tank system; pressure-vacuum treatments resulted in absorptions of 8-9 pcf.

Uses: Furniture, cabinetwork, joinery, paneling, specialty items, boatbuilding, railroad crossties (treated), decorative veneers.

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TETRAMELES NUDIFLORA

THITPOK

Family: Tetramelaceae

Other Common Names: Thitpok (India), Baing, Sawbya (Burma), Mengkundor (Malaya), Som-pong (Thailand).

Distribution: Indo-Malayan region.

THE TREE May reach a height of 150 ft with clear boles to 100 ft and diameters of about 10 ft, more commonly boles are to 50 ft with trunk diameters 3-4 ft; large buttresses.

THE WOOD General Characteristics: Wood whitish when freshly cut, changing to pale yellowish-gray, golden-brown, or light yellow, with a slight olive-green tinge; heartwood and sapwood not differentiated. Texture coarse, grain interlocked in broad bands; lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.30; air-dry density 22pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Seasons with little difficulty but may be severely degraded during drying by stain, decay, and insects. No information on kiln schedules or shrinkage values.

Working Properties: Saws with ease and works to a fairly smooth surface, cuts cleanly when rotary peeled into veneers.

Durability: Highly perishable.

Preservation: No information available.

Uses: Boxes and crates, core stock for plywood, dugouts.

ADDITIONAL READING

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1941-1954. Manual of Malayan timbers. Malayan Forest Rec. 15. 2 vol.
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1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.

TETRAMERISTA GLABRA

PUNAH

Family: Tetrameristicaceae

Other Common Names: Punak (Indonesia), Entuyut (Sarawak and Brunei), Tuyot (Sabah).

Distribution: Malay Peninsula, Borneo, Sumatra; found in coastal swamp forests.

THE TREE Reaches a height of 120 ft and trunk diameters 2-3 ft; boles often fluted; clear to 40-50 ft; without buttresses.

THE WOOD General Characteristics: Heartwood straw-colored or light brown, sometimes tinged with pink; sapwood lighter in color, not clearly differentiated. Texture moderately coarse; grain generally straight; luster low; timber has a waxy feel; has an unpleasant odor when fresh, but this does not persist.

Weight: Basic specific gravity (ovendry weight/green volume) 0.61; air-dry density 45 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength <u>Psi</u>	Modulus of elasticity <u>1,000 psi</u>	Maximum crushing strength <u>Psi</u>
Green (4)*	9,690	1,860	4,570

Janka side hardness 910 lb.

*See "Additional Reading" for reference.

Drying and Shrinkage: The timber dries rapidly but is prone to warping and end checking. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 6.1%; tangential 10.7%; volumetric 17.3%.

Working Properties: The timber saws and machines fairly well; finish after planing tends to be fibrous and requires considerable sanding; tends to split in nailing.

Durability: Rated as moderately durable in Malaysia but generally considered as unsuitable for use in ground contact; prone to sap stain.

Preservation: Heartwood reported to absorb about 4 pcf of preservative oils using the open-tank system and 8 pcf using a pressure treatment.

Uses: General construction, joinery, flooring, furniture components.

ADDITIONAL READING

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1941-1954. Manual of Malayan timbers. Malayan Forest Rec. 15. 2 vol.
3. Farmer, R. H. (ed.).
1972. Handbook of hardwoods. H. M. Stationery Office. London.
4. Lee, Y. H., and Y. P. Chu.
1965. The strength properties of Malayan timbers. Malayan Forester 28(4):307-319.

TRISTANIA SPP.

BRUSH BOX

Family: Myrtaceae

Other Common Names: Pelawan Pelawan (Sabah), Keruntum, Pelawan (Malaya), Selunsur, Melaban (Sarawak), Malabayabas (Philippines).

Distribution: Indo-Malayan region and extending into Australia, the Philippines, and Indonesia. Some species introduced to other tropical areas.

THE TREE Boles 25-40 ft, generally irregular, with pronounced buttresses; diameters to 30 in. Plantation trees of T. conferta of good form in Hawaii.

THE WOOD General Characteristics: Heartwood pink-brown, gray-brown, red-brown, or dark red; sapwood pink- or red-brown, lighter than the heartwood, but not always sharply demarcated. Texture medium to fine; grain interlocked, sometimes wavy; somewhat lustrous; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) variable with species 0.70-0.90; air-dry density 55-70 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (4)*	17,000	2,100	6,950
12%	26,200	2,680	11,700
Green (1)	11,400	1,700	5,650
12%	17,600	2,220	9,270

Janka side hardness 1,760-2,620 lb for green material and 2,045-4,130 lb for dry. Forest Products Laboratory toughness 595 in.-lb for green and 410 in.-lb for dry wood (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Very difficult to season, prone to warping, checking, and collapse; air drying is suggested prior to kiln drying. Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 5.0%; tangential 9.5% and may be considerably higher when collapse is present.

Working Properties: Generally difficult to saw and machine because of high density, cutters may dull rapidly (silica content 0.04-0.22% but values as high as 3.4% are reported); dresses to a smooth surface; turns excellently.

Durability: Heartwood generally reported to be resistant to attack by decay fungi and termites.

Preservation: Very difficult to treat.

Uses: Flooring, pallets, heavy construction, specialty items (pulleys, rollers, bearings, sheaves, tool handles).

ADDITIONAL READING

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Div. For. Prod. Technol. Pap. For. Prod. Aust. No. 25.
2. Burgess, P. F.
1966. Timbers of Sabah. Sabah For. Rec. No. 6.
3. Desch, H. E.
1941-1954. Manual of Malayan timbers. Malayan Forest Rec. 15. 2 vol.
4. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
5. Meniado, J. A. et al.
1973. A report to wood-using industries. Technical information on Malabayabas (Tristania decorticata). Forpride Digest 2(1):10-13,35,67.

UPUNA BORNEENSIS

UPUN BATU

Family: Dipterocarpaceae

Other Common Names: Resak (Sabah), Penyau (Sarawak).

Distribution: Borneo (including Sabah, Sarawak, and Brunei); a lowland forest tree.

THE TREE Reaches a height of 150 ft; with trunk diameter 4-5 ft; boles of good form over stout buttresses.

THE WOOD General Characteristics: Heartwood dark brown when freshly cut, becoming lighter when dry and darkening again on exposure; sapwood light yellow-brown, not always distinct. Texture fine; grain shallowly interlocked; luster low; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.82; air-dry density 63pcf.

Mechanical Properties: Strength values not available but reported to be twice as hard as teak and, except for shock resistance, 50% stronger than teak in other properties.

Drying and Shrinkage: Seasons rather rapidly with only very slight surface checking and end splitting. Information on kiln schedules not available. Shrinkage from green to 15% moisture content: radial 1.0-1.5%, tangential 1.5-2.0%.

Working Properties: Moderately difficult to saw because of high density and gumming of cutters; dresses smoothly in planing with hand or machine tools, some tearing of grain on radial surfaces; bores rather roughly.

Durability: Reported to have good durability in Sarawak.

Preservation: Both sapwood and heartwood are not treatable, sapwood absorbed less than 1 pcf of treating oil using an open-tank treatment.

Uses: Heavy construction.

ADDITIONAL READING

1. Sarawak: For. Dep.
1961. Common Sarawak timbers. Borneo Literature Bureau, Kuching.
2. Thomas, A. V.
1953. The timbers of upun batu (Upuna borneensis). Malayan Forester 16(3):163-165.

VITEX SPP.

MOLAVE

Family: Verbenaceae

Other Common Names: Leban (Malaya), Kulim Papa (Sabah), Teen-nok (Thailand), Milla (India), Bitum (New Guinea), Gupasa (Indonesia).

Distribution: Throughout the Indo-Malayan region including Western Pacific Islands.

THE TREE A small to large tree reaching a height of 120 ft, boles clear to 50 ft, straight and cylindrical, often fluted and irregular; trunk diameters up to 6-7 ft over moderately large buttresses.

THE WOOD General Characteristics: Wood light yellow, yellow-brown, olive- or pinkish-gray, reddish-brown to brown; sapwood lighter in color, not distinctly differentiated. Texture fine to medium fine; grain straight, slightly crossed, or wavy; dull to somewhat lustrous; without characteristic odor or taste, wood chips color water yellow to yellow-green.

Weight: Basic specific gravity (ovendry weight/green volume) varying with species 0.58-0.72; air-dry density 45-55 pcf.

Mechanical Properties: (2-in. standard)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)* 12%	12,500 17,300	1,350 2,000	6,800 9,400
Green (<u>1</u>) 12%	11,600 16,400	1,710 1,970	6,100 9,240
12% (<u>3</u>)	14,760	1,615	6,990

Janka side hardness 1,155 lb for green material and 1,255 lb for dry. Forest Products Laboratory toughness 405 in.-lb for green wood and 330 in.-lb for dry (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Seasons well with little or no degrade, some fine surface checking may develop. No information available on kiln schedules. Shrinkage green to ovendry: radial 4.5%; tangential 6.5%. Small to medium movement in service is reported.

Working Properties: Generally saws and machines well and dresses to a good finish.

Durability: Heartwood reported as very durable; Indian species, though, are questionable.

Preservation: No information available.

Uses: Durable construction, boatbuilding, furniture and cabinetwork, flooring, carving, joinery.

ADDITIONAL READING

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1966. The mechanical properties of 81 New Guinea timbers. Div. For. Prod. Technol. Pap. For. Prod. Aust. No. 41.
2. Lauricio, F. M., and S. B. Bellosillo.
1966. The mechanical and related properties of Philippine woods. The Lumberman 12(5):66+A-H.
3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central Publ. Br., Calcutta.
4. Reyes, L. J.
1938. Philippine woods. Commonwealth of the Philippines. Dep. Agric. and Comm. Tec. Bul. No. 7. Manila.

WALLACEODENDRON CELEBICUM

BANUYO

Family: Leguminosae

Other Common Names: Bulilising, Lupiji, Malatagum (Philippines).

Distribution: Indonesia and the Philippines; found along seacoasts.

THE TREE A large tree with a short clear trunk to 30-40 ft; diameters 4-6 ft.

THE WOOD General Characteristics: Heartwood light golden brown; sapwood lighter in color and quite distinct. Texture moderately fine; grain interlocked, often curly or wavy; lustrous.

Weight: Basic specific gravity (ovendry weight/green volume) 0.57; air-dry density 44pcf.

Mechanical Properties: No information available.

Drying and Shrinkage: Reported to require careful seasoning.

No information available on kiln schedule or shrinkage values.

Working Properties: Easy to work and takes a fine finish.

Durability: Heartwood is suggested for interior use, sapwood is liable to powder-post beetle attack.

Preservation: No information available.

Uses: Gunstocks, furniture and cabinetwork, carvings and sculpture, decorative veneers. The tree is often planted along roadsides.

ADDITIONAL READING

1. Meniado, J. A., R. R. Valbuena, and F. N. Tamolang.
1974. Timbers of the Philippines. Gov. Printing Office, Manila.

XYLIA XYLOCARPA

PYINKADO

Family: Leguminosae

Other Common Names: Pyin (Burma), Cam xe, Sokram (Cambodia).

Distribution: Burma and India and extending eastward into Cambodia and Thailand.

THE TREE Grows to a height of 120 ft; bole straight, cylindrical, and clear to 40 ft; trunk diameters to 4 ft.

THE WOOD General Characteristics: Heartwood reddish-brown with darker streaks, often locally speckled with dark gummy exudations; sapwood pale reddish-white. Grain straight, interlocked, or frequently wavy; texture moderately fine; without luster; without characteristic odor or taste.

Weight: Basic specific gravity (ovendry weight/green volume) 0.72-0.90; air-dry density 52-70 pcf.

Mechanical Properties: (First two sets of data based on the 2-in. standard, third set on the 2-cm standard.)

Moisture content	Bending strength	Modulus of elasticity	Maximum crushing strength
	Psi	1,000 psi	Psi
Green (<u>2</u>)*	15,550	2,265	8,015
10%	20,580	2,530	11,515
Green (<u>2</u>)	11,550	1,655	6,210
14%	15,040	1,975	9,440
12% (<u>4</u>)	21,200	--	12,300

Janka side hardness 1,920-1,950 lb for green material and 2,220-2,275 lb for dry. Amsler toughness 290 in.-lb for dry material (2-cm specimen).

*See "Additional Reading" for references.

Drying and Shrinkage: Reported to dry slowly but with little degrade (some tendency to check and warp). Kiln schedule T3-C2 is suggested for 4/4 stock and T3-C1 for 8/4. Shrinkage green to ovendry: radial 3.3%; tangential 6.7%; volumetric 11.1%. Movement in service is rated as medium.

Working Properties: Blunting of cutters is severe, particularly when dry; can be worked to a smooth finish.

Durability: Heartwood is rated as very durable and rarely attacked by termites.

Preservation: Heartwood extremely resistant to preservative treatments.

Uses: Heavy durable construction, flooring, railway crossties, harbor work.

ADDITIONAL READING

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1972. Handbook of hardwoods. H. M. Stationery Office.
London.
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in India. Third interim rpt. on Proj. 1. Indian For.
Rec. 18(10):1-70.
3. Pearson, R. S., and H. P. Brown.
1932. Commercial timbers of India. Gov. of India Central
Publ. Br., Calcutta.
4. Sallenave, P.
1955. Propriétés physiques et mécaniques des bois
tropicaux de l'union Française. Publ. Centre Tech. For.
Trop. No. 8.

Part II

Tables of

Properties

and Uses

PART II--TABLES OF PROPERTIES AND END USES

This Part II is a supplement to Part I and is designed to help select tropical timbers with a desired set of characteristics that may suggest adequate performance in a particular end-use. Part I can then be referred to for more detailed information on those species of interest.

The properties and uses of some 370 species or generic groupings are coded and presented in table form. Key categories have been selected to minimize the number of columns and permit more rapid screening. Though the tables are a condensation of a vast array of technical data, searches for a particular kind of wood may still be time consuming. The chore can be minimized by transfer of the tabulated information to punchcard sorts or by entry into a computer retrieval system.

Table II-1 codifies the "Physical and Mechanical Properties" and table II-2 shows suggested "End Uses." Explanatory notes follow.

Explanation of Column Headings in Table II-1

Column 1--Scientific Name

Species are listed alphabetically by generic name. If only the trade name is known, appendix B should be searched for a cross reference to the scientific name. If the species still cannot be found, "List of Generic Synonyms" in appendix C should be checked. The species list is a select one with preference to those timbers currently of commercial interest. It is possible then that this compendium does not include the wood being searched. As information about and interest in other species become known, supplementary data sheets will be prepared.

Column 2--Commercial or Trade Name

Many of the better known timbers have several trade names and often dozens of common names, varying from country to country and from region to region within a country. Preference is given to English usage (mahogany rather than caoba, mogno, or acajou).

Column 3--Geographical Region

The regions are coded AM--Tropical America, AF--Africa, and AS--South-east Asia and Oceania. Heading the table for comparison are eight North American woods (USA) having a wide range of characteristics and

uses. The data sheets in Part I are grouped geographically, and this coding permits entry to the proper section when regional location is a primary interest.

Physical and Mechanical Properties of Table II-1

Column 4--Color

Sapwood of most species is light colored, nearly white, yellowish, or light brown. In some species heartwood and sapwood are not clearly differentiated; in others there are distinct color contrasts. Brown is the most common heartwood color, but may also be black, purple, dark reddish-brown, bright yellow, etc. Many of the favored cabinet woods are varigated with attractive streaking. Dark-colored woods often show good resistance to attack by decay fungi because of heavy infiltration of toxic extraneous substances.

The following simplified color coding is used:^{3/}

<u>Code</u>	<u>Color</u>
1	Whitish, pale brown, pale yellow, straw
2	Dark brown
3	Pink or red tints, including red brown
4	Other colors (black, purple, bright yellow, etc.)

Column 5--Density

All of the woods have been classified into six density categories. Density is given in pounds per cubic foot (pcf) and is based on weight and volume at a moisture content of 12 percent (a few laboratories make these measurements at a moisture content of 15 pct). Basic specific gravity (calculated from ovendry weight and green volume) equivalent to the density categories are also shown:

^{3/} From CSIRO, Division Forest Products. n.d. Notes on card sorting key for the timbers of Australia. Council for Scientific and Industrial Research, Division of Forest Products.

<u>Code</u>	<u>Density</u> (Pcf)	<u>Basic specific gravity</u>
1	<20	<0.26
2	20-30	0.26-0.40
3	30-40	.40-.52
4/R4	40-50	.52-.65
5	50-60	.65-.78
6	>60	>.78

Column 6--Bending Strength (12 Pct
Moisture Content)

Most of the mechanical property data was obtained using either ASTM D 143 2-inch specimen or the British Standard No. 373 2-centimeter specimen or equivalent. Modulus of rupture or maximum load-carrying capacity in bending can be compared for the two test methods by:^{5/}

$$\frac{2\text{-in.}}{2\text{-cm}} = 0.95$$

<u>Code</u>	<u>2-Inch specimen</u> (Psi)	<u>2-Centimeter specimen</u> (Psi)
1	<7,000	<7,400
2	7,000- 9,500	7,400-10,000
3	9,500-12,000	10,000-12,600
R4	12,000-14,500	12,600-15,300
5	14,500-17,000	15,300-18,000
6	17,000-19,500	18,000-20,500
7	>19,500	>20,500

Column 7--Stiffness (12 Pct
Moisture Content)

Modulus of elasticity measures the stiffness of beams or long columns. The conversion ratio for the two standard specimen sizes is:^{5/}

$$\frac{2\text{-in.}}{2\text{-cm}} = 1.07$$

^{4/} The location of the "R" here and in the following coded classifications indicates the rating for red oak (USA) as a convenient index.

^{5/} From Lavers, G. M. 1967. The strength properties of timbers. For. Prod. Res. No. 50, HMSO, London.

<u>Code</u>	<u>2-Inch specimen</u> (1,000 Psi)	<u>2-Centimeter specimen</u> (1,000 Psi)
1	<1,000	<930
2	1,000-1,400	930-1,310
3	1,400-1,800	1,310-1,680
R4	1,800-2,200	1,680-2,060
5	2,200-2,600	2,060-2,420
6	2,600-3,000	2,420-2,800
7	>3,000	>2,800

Column 8--Crushing Strength (12 Pct
Moisture Content)

Maximum crushing strength is derived from compression tests parallel to the grain of short columns. The conversion ratio is:^{5/}

$$\frac{2\text{-in.}}{2\text{-cm}} = 0.96$$

<u>Code</u>	<u>2-Inch specimen</u> (Psi)	<u>2-Centimeter specimen</u> (Psi)
1	<5,000	<5,200
2	5,000- 6,000	5,200- 6,250
R3	6,000- 7,000	6,250- 7,300
4	7,000- 8,000	7,300- 8,300
5	8,000- 9,000	8,300- 9,400
6	9,000-10,000	9,400-10,400
7	>10,000	>10,400

Column 9--Toughness (Green or Dry
Test Material)

Toughness measures the capacity of a wood to absorb energy or resist shocks. Assessments may be based on impact bending or work to maximum load in static-bending beam tests. Ratings in the table are derived only from pendulum-type impact loadings using either the toughness testing machine of the Forest Products Laboratory, Madison, or the Amsler or Morh and Federhaff type machines developed in Europe. Some test results are based on specimens 5/8 inch square, 10 inches long, and loaded over an 8-inch span; others on a 2-centimeter-square specimen, 28 centimeters long, loaded over a 24-centimeter span. Tests were made on green material, dry material, or at both moisture content levels.

Studies have been made to measure the effect of machine type, specimen size, and moisture content on toughness. Based on these investigations, comparative values were derived (see appendix E for details).

Code	FPL 5/8- inch green	FPL 5/8- inch dry	FPL 2-cen- timeter green	FPL 2-cen- timeter dry	Amsler 2-cen- timeter green	Amsler 2-cen- timeter dry
	(In.- 1b)	(In.- 1b)	(In.-1b)	(In.-1b)	(In.-1b)	(In.-1b)
1	<80	<100	<145	<180	<145	<135
2	80-120	100-150	145-220	180-270	145-220	135-200
3	120-160	150-200	220-290	270-360	220-290	200-270
R4	160-200	200-250	290-360	360-450	290-360	270-330
5	200-240	250-300	360-430	450-540	360-430	330-400
6	240-280	300-350	430-500	540-630	430-500	400-470
7	>280	>350	>500	>630	>500	>470

Column 10--Janka Hardness (12 Pct
Moisture Content)

Hardness is a measure of the wood's resistance to indentation and also indicates the ability of the material to withstand abrasion.

Values are the load in pounds required to embed a steel ball 0.444 inch in diameter to a depth of 0.222 inch or a projected area of 1 square centimeter. Ratings are based on side-grain testing only.

Code	Janka side hardness (Lb)
1	<500
2	500- 300
3	800-1,100
R4	1,100-1,400
5	1,400-1,700
6	1,700-2,000
7	>2,000

Column 11--Movement

Movement is a measure of how well a wood stays in place or shrinks and swells with moisture loss or gain after seasoning. It is based on the sum of tangential and radial shrinkage percentages corresponding to a change in relative humidity from 90 percent to 60 percent at room temperature.^{2/}

<u>Code</u>	<u>Movement</u> (Pct)
1	Small, under 3.0
2	Medium, 3.0-4.5
3	Large, over 4.5

Column 12--Shrinkage

Wood shrinks with moisture loss from cell walls. Shrinkage from the saturated wall condition (fiber saturation point) to the ovendry condition is almost linear. Tangential and radial shrinkages from the green to ovendry condition and green to airdry condition (12-15 pct moisture content) are classified. Generally woods with a low shrinkage rating tend to have small movement.

<u>Code</u>	<u>Radial, green to--</u>		<u>Tangential, green to--</u>	
	<u>Ovendry</u> (Pct)	<u>Airdry</u> (Pct)	<u>Ovendry</u> (Pct)	<u>Airdry</u> (Pct)
1	<3.0	<2.0	<5.0	<3.0
2	3.0-4.0	2.0-2.5	5.0-6.5	3.0-4.0
3	R4.0-5.0	2.5-3.0	6.5-8.0	4.0-5.0
4	5.0-6.0	3.0-3.5	R8.0-9.5	5.0-6.0
5	>6.0	>3.5	>9.5	>6.0

Column 13--Durability

Classifications refer to the natural durability or resistance to attack by decay fungi. Ratings are for heartwood and do not indicate resistance to insect or marine borer attack. Wood properly seasoned and stored under shelter or used under dry conditions will not decay. The classifications are based on the performance of heartwood test stakes in ground contact under long-term outdoor exposure or actual reports of in-use experience in deleterious environments. Ratings follow the Princes Risborough Laboratory classifications.^{2/}

<u>Code</u>	<u>Classification</u>	<u>Approximate life in ground contact</u> (Yr)
1	Very durable	>25
2	Durable	15-25
3	Moderately durable	10-15
R4	Nondurable	5-10
5	Perishable	<5

Column 14--Treatability

Perishable, nondurable, and moderately durable woods can have their service life extended, even under the most severe exposure conditions, by a suitable preservative treatment. Not only may resistance to attack by decay fungi be enhanced, but also resistance to wood-destroying insects and marine borers.

Permeability and thus treatability may vary considerably between species and between sapwood and heartwood within species. Classifications are for heartwood only and should be used with reservation because evaluations are nonstandard--some are based on pressure-treating systems and some on nonpressure systems, using a wide range of specimen sizes with or without end-grain coatings.

Ratings range from "permeable" where there is deep chemical penetration and high absorption to "extremely resistant" for timbers that have a very shallow penetration of preservative solution and a negligible absorption.

<u>Code</u>	<u>Treatability</u>
1	Permeable
R2	Moderately resistant
3	Resistant
4	Extremely resistant

Uses--Table II-2

If timber supplies are diverse and abundant, special end-use markets can develop for species with unique characteristics. For instance in our domestic timber trade we see western redcedar--shingles and shakes, eastern redcedar--pencils, white oak--tight cooperage, basswood--excelsior, hickory--smoke. Recently selection for particular end-uses has become less definitive due to the changing character of the forest resource. Many products such as particleboard, fiberboard, plywood, and pulp and paper are becoming less dependent of species.

Most uses shown in the table are based on experiences in other countries where wood products are often marketed under a different economic structure and standard of performance. This limitation should be kept in mind when scanning the table for likely raw material supplies.

All possible uses for wood could not be listed. Many applications such as pencil slats, bobbins and shuttles, and golf club heads could not be given separate headings. These are grouped under "Specialty Items." For the exact specialty, refer to the data sheets in Part I.

If a domestic wood has been performing well in a particular application not noted, and substitute supplies are required, consult the columns dealing with physical and mechanical properties to find woods with similar characteristics. Whether selected from the "use" or "property" part of the table, unfamiliar woods should be introduced to new applications with caution; tradition, too, plays a key role in many wood uses.

Summary Reference Sheet for Decoding Table II-1

Code	COLOR	DENSITY		MECHANICAL PROPERTIES (12 PCT MOISTURE CONTENT)				HEARTWOOD TREATABILITY
		Code	Density (Pcf)	Code	Bending strength (2-in. specimen) (Psi)	Stiffness (2-in. specimen) (1,000 psi)	Crushing strength (2-in. specimen) (Psi)	
1	Whitish, pale brown, pale yellow, straw	1	<20	—	—	—	—	Hardness, Janka side
2	Dark brown	1	20-30	—	—	—	—	—
3	Pink or red tints, including red brown	2	30-40	—	—	—	—	—
4	Other colors (black, purple, bright yellow, etc.)	3	40-50	1	<7,000	<1,000	<5,000	<300
		4	50-60	2	7,000-9,500	1,000-1,400	5,000-6,000	500-300
		5	>60	3	9,500-12,000	1,400-1,800	6,000-7,000	800-1,100
		6		4	12,000-14,500	1,800-2,200	7,000-8,000	1,000-1,400
				5	14,500-17,000	2,200-2,600	8,000-9,000	360-450
				6	17,000-19,500	2,600-3,000	9,000-10,000	450-540
				7	>19,500	>3,000	>10,000	1,400-1,700
							>630	1,700-2,000
								>2,000
MOVEMENT								
Code	Movement (Pct.)	Code	Radial overdry (Pct.)	Green to overdry (Pct.)	Tangential overdry (Pct.)	Green to airdry (Pct.)	Classification	Code
1	Small, under 3.0	—	—	—	—	—	Very durable	1
2	Medium, 3.0-4.5	—	—	—	—	—	Durable	2
3	Large--over 4.5	1	<3.0	<2.0	<5.0	<3.0	Moderately indurables	3
		2	3.0-4.0	2.0-2.5	5.0-6.5	3.0-4.0	Indurables	4
		3	4.0-5.0	2.5-3.0	6.5-8.0	4.0-5.0	Perishable	5
		4	5.0-6.0	3.0-3.5	8.0-9.5	5.0-6.0		
		5	>6.0	>3.5	>9.5	>6.0		
SHRINKAGE								
Code	Movement (Pct.)	Code	Green to overdry (Pct.)	Green to overdry (Pct.)	Tangential overdry (Pct.)	Classification	Code	Classification
1	Small, under 3.0	—	—	—	—	—	1	Permeable
2	Medium, 3.0-4.5	—	—	—	—	—	2	Moderately resistant
3	Large--over 4.5	1	<3.0	<2.0	<5.0	<3.0	3	Resistant
		2	3.0-4.0	2.0-2.5	5.0-6.5	3.0-4.0	4	Extremely resistant
		3	4.0-5.0	2.5-3.0	6.5-8.0	4.0-5.0		
		4	5.0-6.0	3.0-3.5	8.0-9.5	5.0-6.0		
		5	>6.0	>3.5	>9.5	>6.0		

Tables II-1 and II-2
appear next with facing tables
that give properties and users
for individual species.

Table II-1.--Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species

Scientific Name ^{1/}	Commercial Name	Geo-graphic region	Color	Density	Mechanical properties					Other properties			
					Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Moving- ment	Shrinkage Rad.	Durability Tan.	Treatability (heart- wood)
EIGHT U.S. SPECIES FOR COMPARISON													
Acer saccharum	Sugar maple	USA	3	4	5	4	4	5	5	2	3	5	4
Carya ovata	Shagbark hickory	USA	1,3	4	7	4	6	7	--	--	5	5	2
Liriodendron tulipifera	Eastern white pine	USA	1,4	2-3	3	3	2	2	2	--	3	4	3
*Pinus strobus	Northern red oak	USA	1,3	2	2	1	1	1	1	1	2	3	3-4
*Pinus taeda	Loblolly pine	USA	3	3	4	3	4	2	2	--	3	3	2-3
*Pseudotsuga menziesii	Douglas-fir	USA	3	4	4	4	3	3	1	1	3	3	4
Quercus alba	White oak	USA	1	4	5	3	4	4	4	2	4	5	2
Quercus rubra		USA	1,3	4	4	3	4	4	4	--	3	4	4
TROPICAL TIMBERS OF THE WORLD													
Acacia melanoxylon	Aust. blackwood	AS	1,2	4	4-5	4-5	5	5	3	4	2	2	4
Acacia mollissima	Black wattle	AS	1	4	5	5	5	--	6	3	--	--	5
Adina cordifolia	Hallu	AS	1,3	4	4	2	3-5	2	4	3	2	1	3-4
Afzelia spp.	Afzelia	AF	3	5	5-6	6-7	6-7	--	6	1	1	1	4
*Agathis spp.	Kauri	AS	1,3	3	3-4	3-4	2-3	--	2-3	--	3	2	3-4
Albizia lebbek	Kokko	AS	2	3	4-5	4	4-7	3	4-5	--	1	2	3
Albizia falcataria	Batai	AS	1,3	2	2	2	1	2	1	1	2	2	5
Albizia spp.	Albizia	AF	1,2,3	3-4	2-4	2-3	3	--	2-4	1	1	1	3
Alexa imperatricis	Haiari	AM	1	3	3	3	2	2	2	3	3	4	1
Alstonia congensis													
and A. boonei	Alstonia	AF	1	2	1-2	1-2	1	1	1	--	2	2	5
Alstonia spp.	Pulai	AS	1	2	2	2	1	4	1	--	2	2	5
Amoora spp.	Amoora	AS	3	3-5	--	4	3	3	--	--	3	3	--
Anacardium excelsum	Espave	AM	1	3	2	2	1	1	1	--	1	2	3-5
Anadenanthera macrocarpa	Curupay	AM	3	6	7	5	7	7	7	2	3	3	4
Andira inermis	Angelim	AM	3	4-5	6-7	5-6	6	--	5	--	3	5	3

^{1/} Conifers are marked with an asterisk; others are hardwoods.

Table II-2.-Uses for various tropical timbers of the world, compared to eight U.S. species

Name	Construction Heavy Light	Shakes and shingles	Joinery and mill- work	Floor- ing	Marine use	Musical instruments	Carvings	Ply- wood	Decor- ative veneer	Furniture and cabinet work	Turnery handles	Tool handles	Reconstituted products (pulp, paper, PB, PB)	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items	
EIGHT U.S. SPECIES FOR COMPARISON																			
<i>Acer saccharum</i>		X							X							X	X	X	X
<i>Carya ovata</i>		X						X								X	X	X	X
<i>Liriodendron</i>																			
<i>*Pinus strobus</i>			X				X		X						X		X		X
<i>*Pinus taeda</i>		X	X				X		X						X	X	X	X	X
<i>*Pseudotsuga menziesii</i>		X	X				X		X						X	X	X	X	X
<i>Quercus alba</i>				X	X					X					X		X	X	X
<i>Quercus rubra</i>				X	X					X					X		X	X	X
TROPICAL TIMBERS OF THE WORLD																			
<i>Acacia melanoxylon</i>					X				X						X		X		X
<i>Acacia mollissima</i>					X				X						X		X		X
<i>Adina cordifolia</i>					X				X						X		X		X
<i>Afzelia</i> spp.					X				X						X		X		X
<i>*Agathis</i> spp.					X				X						X		X		X
<i>Albizia lebbeck</i>					X				X						X		X		X
<i>Albizia Falcataria</i>						X				X					X		X		X
<i>Albizia</i> spp.						X				X					X		X		X
<i>Alexa Imperatricis</i>							X				X				X		X		X
<i>Alistonias congensis</i> and <i>A. Boonei</i>							X			X					X		X		X
<i>Alistonia</i> spp.								X				X			X		X		X
<i>Anoora</i> spp.								X			X				X		X		X
<i>Anacardium excelsum</i>								X			X				X		X		X
<i>Adenanthera</i> <i>macrocarpa</i>								X			X				X		X		X
<i>Andira inermis</i>								X			X				X		X		X

1/ Conifers are marked with an asterisk; others are hardwoods.

Table II-1.--Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species--continued

Scientific Name ^{1/}	Commercial Name	Geo- graphic region	Color	Density	Mechanical properties					Other properties		
					Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Movement	Shrinkage	Durability
TROPICAL TIMBERS OF THE WORLD--continued												
<i>Androstachys johnsonii</i>	Mecrusse	AF	3	5	6	--	6	--	7	--	4	2
Aniba spp.	Louro	AM	1	4	6	5	7	3	5	3	3	1
<i>Aningeria</i> spp.	Aningeria	AF	1,3	3	2-5	2-3	2-4	3	2-4	--	2	4
<i>Antisoptera</i> spp.	Mersawa	AS	1	3-4	4-6	3-5	4-5	6	3	3	5	1
<i>Anthocephalus chinensis</i>	Cadam	AS	1	2	3	2	2-3	3	2	1	2	5
<i>Antiaris</i> spp.	Antiaris	AF	1	2	2	1-2	1-2	1	1	2	3	5
<i>Apieba</i> spp.	Duru	AM	1	1-2	1	1	1	--	1	1	2	5
* <i>Araucaria angustifolia</i>	Parana-pine	AM	1,3	3	4	3	3-4	2	2	2	3	5
* <i>Araucaria</i> spp.	Hoop-pine	AS	1,3	3	3-4	3-4	2-4	2	1	2	2	5
<i>Artocarpus</i> spp.	Keldang	AS	1,2	3-5	4	2-3	3-5	4	4	--	1	2
<i>Aspidosperma</i> spp.	Aracanga	AM	1,3	5-6	7	6-7	7	3-5	6-7	--	4	4
<i>Aspidosperma</i> spp.	Peroba rosa	AM	1,2	4	4	3	4	3	6	--	2	3
<i>Astronium graveolens</i>	Gonçalo alves	AM	3	5	5-6	4-5	7	2	7	--	3	3
<i>Astrocarya</i> spp.	Okoume	AF	3	2	3	2	2	2	1	--	3	2
<i>Autranella congolensis</i>	Iifikungu	AF	3	5	7	5	7	4-6	--	3	4	3
<i>Azadirachta</i> spp.	Neem	AS	3	4	3-4	2	3-4	--	5	1	2	3
<i>Baigassa guianensis</i>	Bagasse	AM	1	5	7	5	7	3	6	--	4	4
<i>Baikiaea insignis</i>	Nkobakoba	AF	1	5	6	6	6	--	6	2	2	3
<i>Baikiaea plurijuga</i>	Rhodesian-teak	AF	3	5	4	2	6	--	7	1	1	4
<i>Baillonella toxisperma</i>	Moabi	AF	3	5	7	5	7	3-7	--	1	4	3
<i>Balanocarpus</i> spp.	Chengal	AS	2	5	7	6	7	--	7	--	--	1
Balfourodendron riedelianum	Pau marfim	AM	1	4-5	6	--	5	7	--	3	4	4
Beilschmiedia tawa	Tawa	AS	1	4	5	4	5	--	5	--	--	3
<i>Berlinia</i> spp.	Berlinia	AF	3	4	4-5	2-4	4	2	4	2	3	3
<i>Bertholletia excelsa</i>	Brazil-nut tree	AM	1	4	5	3	3	2	4	--	2	4
<i>Bischofia javanica</i>	Bishopwood	AS	3	3-5	5	3	4-5	2	4	--	3	2-5
<i>Bombacopsis quinata</i>	Pochote	AM	3	3	3-4	3	2-3	2	2	--	2	3
<i>Bombax</i> spp.	Bombax	AF	1,3	2-3	1-3	1-2	1-2	1	1	1	3	2-4
<i>Boddaitchia</i> spp.	Sucupira	AM	3	5	6	--	7	6	--	4	3	--
<i>Brachylaena hutchinsii</i>	Muhunu	AF	1,4	5	5	3	6	--	7	1	2	1
<i>Brachystegia</i> spiciformis	Itundu	AF	1,3	5	6	4	6	--	6	2	3	4
<i>Brachystegia</i> spp.	Okwen	AF	1,2	3-4	3-4	2-3	2-4	--	3-5	2	2	3
<i>Brosimum</i> spp. (Alicastrum group)	Capotao	AM	1	4-6	3	4	5	--	4-5	--	4	5
<i>Brosimum</i> spp. (Utile group)	Cow tree	AM	1	2-3	4	5	5	--	3	--	2	5
<i>Buchenavia capitata</i>	Yellow sanders	AM	1	4	4	3	4	2	4	--	1	3
<i>Bucida buceras</i>	Jucaro	AM	1,4	6	--	--	--	--	--	3	3	3
<i>Bucklandia populnea</i>	Pipli	AS	3	3	3-5	2-4	2-5	--	4	--	--	3
<i>Bulnesia arborea</i>	Veravoo	AM	4	6	--	--	--	--	--	--	--	4
<i>Burkea africana</i>	Burkea	AF	2-3	4-6	--	--	--	--	--	1	1	4
<i>Bursera simaruba</i>	Gumbo-limbo	AM	1	1-2	1	1	1	1	1	--	1	1

Table II-2.—Uses for various tropical timbers of the world, compared to eight U.S. species—continued

Name ^{1/}	Construction	Shakes and shingles	Joinery and mull-work	Flooring	Marine use	Musical instruments	Instruments	Carvings	Plywood	Decorative veneer	Furniture and cabinet work	Turnery	Tool handles	Reconstituted products	Vats and tanks	Cooperage	Boxes and crates	Cross-ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																			
<i>Androstachys johnsonii</i>	X			X															X
<i>Aniba</i> spp.	X			X															
<i>Aningeria</i> spp.				X															
<i>Anisotoma</i> spp.	X			X															
<i>Anthocephalus chinensis</i>	X			X															X
<i>Antiaris</i> spp.	X			X															
<i>Apieba</i> spp.																			
* <i>Araucaria angustifolia</i>	X			X															
* <i>Araucaria</i> spp.																			
<i>Artocarpus</i> spp.	X			X				X											
<i>Aspidosperma</i> spp. <i>Aracanga</i>																			
<i>Aspidosperma</i> spp. <i>Pereoba rosa</i>	X			X				X											
<i>Astronium graveolens</i>	X			X				X											
<i>Aucoumea klaineana</i>																			X
<i>Aurantea congolensis</i>	X			X				X											X
<i>Azadirachta</i> spp.																			
<i>Baikiaea plurijuga</i>	X																		
<i>Baikiaea insignis</i>	X																		
<i>Baikiaea plurijuga</i>																			
<i>Baikiaea toxisperma</i>																			
<i>Balanocarpus</i> spp.	X																		
<i>Balfouriodendron</i>																			
<i>Bellaiedianum</i>																			
<i>Beilschmiedia tawa</i>																			X
<i>Berlinia</i> spp.	X																		
<i>Bertholletia excelsa</i>	X																		X
<i>Bischofia javanica</i>																			
<i>Bombacopsis quinata</i>	X																		
<i>Bombax</i> spp.																			
<i>Bowdichia</i> spp.	X																		
<i>Brachylaena hutchinsii</i>																			
<i>Brachystegia spiciformis</i>	X																		
<i>Brachystegia</i> spp.																			
<i>Brachystegia spiciformis</i>	X																		
<i>Brochimus</i> spp. (Alliactrum group)	X																		
<i>Brochimus</i> spp. (Utile group)	X																		
<i>Buchenavia capitata</i>																			
<i>Bucida buceras</i>																			X
<i>Bucklandia populea</i>	X																		
<i>Buinesia arborea</i>																			X
<i>Burkea africana</i>																			X
<i>Bursera simaruba</i>	X																		X

Table II-1.--Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species--continued

Scientific Name ^{1/}	Name ^{1/}		Geo- graphic region	Color	Density	Mechanical properties				Other properties			
	Commercial	Agricultural				Bending strength	Stiffness	Crushing strength	Toughness	Hardness	Movement	Shrinkage	Durability
										Rad.	Tan.	(heartwood)	
TROPICAL TIMBERS OF THE WORLD--continued													
<i>Byrsinima</i> spp.	Serrete	AM	3	4	5-6	4	6	2	5	--	3	4	4
<i>Cabralea cagerana</i>	Cangerana	AM	3	4	4	--	4	2	2	--	2	1	2
<i>Caesalpinia</i> spp.	Partridgewood	All	3,4	6	--	--	--	--	--	--	--	--	--
* <i>Calitris glauca</i>	White cypress-pine	AS	1	4	3	2	4	1-2	4	--	2	1	4
<i>Calophyllum brasiliense</i>	Santa maria	AM	3	3	5	4	3-5	3	4	2	3	3	4
<i>Calophyllum</i> spp.	Bintangor	AS	3	3-4	4	3	4-5	2	5	--	2	2	4
<i>Calycophyllum candidissimum</i>	Degame	AM	1	5	7	5	6	5	6	--	3	4	--
<i>Camphosperma panamensis</i>	Sajo	All	1	2	2	3	2	--	1	--	--	5	1
<i>Canarium odoratum</i>	Cananga	AS	1,3	2	1	2	1	2	1	--	2	3	--
<i>Canarium schweinfurthii</i>	African canarium	AF	3	2-3	2	1-2	1	2	1	2	3	3	4
<i>Canarium</i> spp.	Kedondong	AS	1,3	2-3	--	--	3	--	--	--	4	5	4
<i>Carapa guianaensis</i>	Crabwood	AM	3	4	5	4-5	4-5	2	4	1	2	3	2-4
<i>Carapa procera</i>	African crabwood	AF	3	4	--	--	--	--	--	1-2	--	--	3
<i>Albarico</i>	Albarico	AM	3	3	3-4	3	3	3	3	1	1	2	4
<i>Piquia</i>	Piquia	AM	1	5	6	4	5	3	6	--	4	4	--
<i>Casearia battiscombei</i>	Muirungi	AF	1,3	3-4	3	3	3	--	2	--	1	3	5
<i>Cassipourea malosana</i>	Pillarwood	AF	1	4	5-6	3	5-6	--	4-5	2	4	5	1
<i>Gastanopis</i> spp.	Berangan	AS	1,2	4	3	2	2	--	--	--	--	5	4
<i>Casuarina</i> spp.	Casuarina	AS	3	6	7	4-7	7	2	7	--	5	5	3
<i>Catostemma</i> spp.	Baromalli	AM	1,3	3-4	3-5	4-6	3-5	3	2	3	4	5	1
<i>Cecropia peitata</i>	Trumpet-wood	AM	1	2	1-2	2	1	1	1	--	1	2	5
<i>Cedrela</i> spp.	Spanish-cedar	AM	3	2-4	3	2-3	2-3	2	2	1	3	2	2
<i>Cedrela</i> spp.	Toon	AS	3	3	2-3	2-3	2-3	2	2	2	2	3	2
<i>Cedrela</i> spp.	Cedro-rana	AM	1,3	3	--	--	--	--	--	--	--	--	3
<i>Ceiba pentandra</i>	Ceiba	AM, AF	1,3	1-2	1	1	1	1	1	1	1	2	5
<i>Celtis</i> spp.	African celtis	AF	1	4	3-7	4-5	2-7	--	5	2	4	5	2
<i>Centrolobium</i> spp.	Arariba	AM	1,3	4-5	5	4-6	4	3	--	1	2	1	3
<i>Cephalosphaera usambarensis</i>	Mtambara	AF	3	3	4	5	3	--	2	3	4	5	2
<i>Chlorophora excelsa</i>	Iroko	AF	1,2	4	3-4	3	3-5	2-3	4	1	1	1	4
<i>Chlorophora tinctoria</i>	Fustic	AM	1	5	7	4	7	4	7	--	2	2	1
<i>Chloroxylon swietenia</i>	East Indian satinwood	AS	1	6	5	4	7	--	7	--	4	3	--
<i>Chukrasia tabularis</i>	Chickrassy	AS	1,3	4	2	3	3	--	4	1	2	2	4
<i>Cinnamomum</i> spp.	Cinnamon wood	AS	1,3	2-3	3	--	2	1	--	--	--	2-4	--
<i>Clarisia racemosa</i>	Oiticica amarela	AM	1	4	3-6	5	6	3	4-5	1	1	2	3
<i>Clathrotrrops</i> spp.	Aromata	AM	2,3	6	7	7	7	7	7	--	3	3	--

Table II-2.--Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name ¹	Construction	Shakes Heavy	Shakes Light	Joinery and shingles	Floor- ing mill- work	Marine use	Musical instru- ments	Ply- wood	Decor- ative veneer	Furniture and cabinet work	Tool handles	Turnery handles	Cooper- age	Boxes and cretes	Cross- ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																
<i>Byrsonima</i> spp.	X	X	X	X		X	X	X	X	X						
<i>Cabralea canjerana</i>																
<i>Cesalpinia</i> spp.	X	X	X	X	X	X	X	X	X	X						
* <i>Calitria glauca</i>																
<i>Calophyllum brasiliense</i>	X				X						X					
<i>Calophyllum</i> spp.	X				X						X					
<i>Glyciphyllum candidissimum</i>																
<i>Campomanesia panamensis</i>					X						X					
<i>Canarium odontatum</i>					X	X					X				X	X
<i>Canarium schweinfurthii</i>					X						X					
<i>Cararium</i> spp.	X				X	X					X					
<i>Carapa guianensis</i>					X	X					X					
<i>Carapa procera</i>					X	X					X					
<i>Caricomia pyrifolia</i>	X				X	X					X					
<i>Caryocar</i> spp.					X	X					X					
<i>Cecropia battiscombei</i>					X						X					
<i>Casuarina malosana</i>					X						X					
<i>Castanopsis</i> spp.	X	X	X								X					
<i>Casuarina</i> spp.		X														
<i>Catocala</i> spp.		X														
<i>Cecropia peltata</i>																
<i>Cedrela</i> spp. Spanish-cedar						X		X	X	X						
<i>Cedrela</i> spp. Toon						X		X	X	X						
<i>Cerelella cateniformis</i>	X					X					X					
<i>Ceiba pentandra</i>	X					X					X					
<i>Celtis</i> spp.		X					X				X					
<i>Centrolobium</i> spp.	X					X		X			X					
<i>Cephalophaea usambarensis</i>	X					X		X			X					
<i>Chiorphora excelsa</i>						X	X	X			X				X	X
<i>Chiorphora tinctoria</i>	X					X		X			X					
<i>Chloroxylon swietenia</i>						X					X					
<i>Chukrasia tabularis</i>									X		X			X		X
<i>Cinnamomum</i> spp.											X					
<i>Clarias racemosa</i>	X					X					X					
<i>Cithartrotropis</i> spp.						X					X					

Table II-1.—Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species—continued

Scientific Name ^{1/}	Commercial Name	Geo-graphic region	Color	Density	Mechanical properties					Other properties			
					Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Mov- ement	Shrinkage	Durability	Treatability (heartwood)
TROPICAL TIMBERS OF THE WORLD—continued													
<i>Combretodendron macrocarpum</i>	<i>Essia</i>	AF	3	5	5-6	3-5	4-7	3	7	3	4	5	2-3
<i>Copifera</i> spp.	<i>Copaiba</i>	AM	3	3-4	3-7	6	2-7	4	6	—	3	4	1-4
<i>Cordia millenii</i>	<i>West African cordia</i>	AF	1,3	2	2	1	1	2	1	2	1	3	3
<i>Cordia</i> spp.	<i>Cordia</i>	AS	1,2,4	3-4	—	—	—	—	—	1	2	2-5	—
<i>Cordia</i> spp. (Aliodora group)	<i>Freijo</i>	AM	1	3	3-4	3-4	2-4	2-3	3	1	2	3	2-3
<i>Cordia</i> spp. (Cerasanthus group)	<i>Canaleta</i>	AM	3	4-6	5-6	3	3	5	7	1	3	3	1
<i>Cordyla africana</i>	<i>Cordyla</i>	AF	1	5	3	3	5	—	5	2	5	4	—
<i>Cotylelobium</i> spp.	<i>Resak</i>	AS	3	4-6	5-7	5	4-5	5	5	—	3	4	1-2
<i>Couna macrocarpa</i>	<i>Cow tree</i>	AM	1,3	3	5	—	4-5	—	3	—	2	2	—
<i>Curatari</i> spp.	<i>Iahot</i>	AM	1,3	3	4-6	3-4	4-5	2	3	—	3	3	2-4
<i>Cratoxylon arborens</i>	<i>Geronggang</i>	AS	3	2-3	1	2	1	—	1	—	3	3	5
<i>Croton negalocarpus</i>	<i>Iusine</i>	AF	1,2	4	—	4	—	4	4	3	—	5	1
<i>Cryptocarya</i> spp.	<i>Rose-maple</i>	AS	3	3-5	4-7	3-6	3-7	2-3	5-7	—	3	3	2-4
* <i>Cupressus lusitanica</i>	<i>Mexican cypress</i>	AM	1,3	3	3-4	2	2	2	1	—	—	—	2-4
<i>Cyathostax donnell-smithii</i>	<i>Primavera</i>	AM	1	2	3	2	2	1	2	1	2	2	2-4
<i>Cylindrodiscus gabunensis</i>	<i>Okan</i>	AF	3	6	6-7	5-6	7	6	7	—	4	4	4
<i>Cynodendron</i> spp.	<i>Caimito</i>	AM	1,2,3	5-6	6-7	7	7	2	2	—	5	4	3
<i>Cynometra alexandri</i>	<i>Muhimbili</i>	AF	3	5	7	4-5	7	—	7	2	3	3	—
<i>Cynometra</i> spp.	<i>Kekatong</i>	AS	3	6	6-7	5-6	6	—	7	—	3	3	2
* <i>Dacrydium</i> spp.	<i>Rimbu</i>	AS	1,3	3	2-3	2	2	—	2	—	4	5	3
<i>Dactyodes excelsa</i>	<i>Commer</i>	AM	3	3-4	4	3	4	—	3	—	3	2	4
<i>Dactyodes</i> spp.	<i>Adjouaba</i>	AF	3	4-5	5-6	4-6	4-6	1-6	—	—	5	4	4
<i>Dactylocladus</i>	<i>Jongkong</i>	AS	3	3	2-4	3	1-4	1	2	—	2	3	—
<i>stenostachys</i>	<i>African rosewood</i>	AS	4	5	5	2-3	6	—	7	1	1	2	5
<i>Dalbergia latifolia</i>	<i>African blackwood</i>	AF	4	6	7	7	7	6	—	1	—	1	—
<i>Dalbergia nigra</i>	<i>Brazilian rosewood</i>	AM	4	4-5	6	4	6	—	7	—	1	1	—
<i>Dalbergia retusa</i>	<i>Cocobolo</i>	AM	4	6	—	—	—	—	—	—	—	—	—
<i>Dalbergia stevensoni</i>	<i>Honduras rosewood</i>	AM	4	5-6	—	—	—	—	—	1	—	1	—
<i>Danieliella ogea</i>	<i>Ogea</i>	AM	3	3	2-3	2-3	2	1	2	—	2	4	5
<i>Dendropanax arboreus</i>	<i>Angelica tree</i>	AM	1	3	2-3	3	1	—	2	—	4	4	5
<i>Dialium dinklagei</i>	<i>Ejoum</i>	AF	3,4	5-6	4-7	4-6	6-7	2-7	—	—	3	3	1
<i>Dialium guaiense</i>	<i>Jutany</i>	AM	3	6	7	6	7	—	7	—	4	4	4
<i>Dialium</i> spp.	<i>Keranji</i>	AS	3,4	6	7	6-7	7	7	7	—	5	5	3
<i>Diayanthihera</i> spp.	<i>Guangare</i>	AM	3	2	2-3	3-4	1	—	1	—	3	4	5
<i>Dicorynia guianensis</i>	<i>Bastralocus</i>	AM	3	4-5	6	4	5	3	4	1	3	4	2

Table II-2.--Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name ^{1/}	Construction Heavy Light	Shakes and shingles	Joinery and mill- work	Floor- ing	Marine use	Musical instru- ments	Ply- carvings	Decor- ative veneer	Furniture and cabinet work	Tool handles	Reconstituted products (pulp, paper, PB, FB)	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																
Combretodendron macrocarpum	X	X		X					X		X					
<i>Copifera</i> spp.																
<i>Cordia milletii</i>																
<i>Cordia</i> spp.																
<i>Cordia</i> spp. (Aliiodora group)	X			X	X				X	X						X
<i>Cordia</i> spp. (Gerasanthus group)	X															
<i>Cordyla africana</i>	X															
<i>Coccylolobium</i> spp.	X				X	X				X	X					X
<i>Couma macrocarpa</i>	X								X		X					X
<i>Couratari</i> spp.	X								X		X					X
<i>Cratoxylon arboreum</i>	X	X							X							
<i>Croton megalocarpus</i>	X				X	X			X							
<i>Cryptocarya</i> spp.	X								X							
* <i>Cupressus lusitanica</i>																
<i>Cybistax donnell-smithii</i>	X								X							
<i>Cylindrodiscus gabunensis</i>	X				X	X										X
<i>Cynometra</i> spp.																
<i>Cynometra alexandri</i>	X				X	X										
* <i>Dacrydium</i> spp.	X															
<i>Dactyodes excelsa</i>	X			X	X					X	X					
<i>Dactyodes</i> spp.																
<i>Dactylocladus</i>	X			X	X				X		X					
<i>Stenostachys</i>																
<i>Dalbergia latifolia</i>									X	X	X					
<i>Dalbergia melanoxylon</i>									X							
<i>Dalbergia nigra</i>									X	X	X					
<i>Dalbergia retusa</i>									X							
<i>Dalbergia stevensoni</i>									X	X	X					
<i>Dantella ogea</i>									X	X	X					
<i>Dendropanax arboreus</i>	X								X	X	X					X
<i>Dialium dinklagei</i>																X
<i>Dialium</i> spp.	X															X
<i>Dialium laetevirese</i>																
<i>Dialianthera</i> spp.																
<i>Dicorynia guianensis</i>	X								X	X	X					X

Table II-1.—Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species—continued

Scientific Name ^{1/}	Name ^{1/}		Geo- graphic region	Color	Density	Mechanical properties					Other properties		
	Commercial	Geographic				Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Moving- movement	Shrinkage	Durability
											Rad.	Tan.	(heart- wood)
<i>Didelotia brevianiculata</i>	Sapo	AF	1	4	2-4	4	4	4	4	—	2	4	3
<i>Didymopanax morototoni</i>	Moroto	AM	1	2-3	3-4	4-5	3	2-5	1	2-3	—	4	5
<i>Dillenia spp.</i>	Simpoh	AS	3	3-5	4-5	5	2	4	5	2-3	—	4	3
<i>Diospyros spp.</i>	African ebony	AF	4	6	7	6	5-7	4	7	—	5	5	4
<i>Diospyros spp.</i>	East Indian ebony	AS	4	4-5	3-6	3-4	2-6	5	6	—	4	4	—
<i>Dipterocarpus purpurea</i>	Sucupira	AM	1	5	7	6-7	7	4	7	—	3	3	1-3
<i>Dipterocarpus spp.</i>	Keruing	AS	2,3	4	5-7	4-5	5-7	3	5	2-3	5	5	3
<i>Dipteryx odorata</i>	Tonka	AM	1	6	7	7	7	5	7	—	3	3	3
<i>Distemomanthus benthamianus</i>	Ayan	AF	1	4	5-6	3	5-6	3	4	1	2	3	3
<i>Dracontomelum spp.</i>	Paldao	AS	1,3	3-4	3-5	3-4	3-4	7	3-4	—	2	3	4
<i>Dryobalanops spp.</i>	Kapur	AS	3	4	5	4-6	5-6	—	4	2	3	5	4
<i>Dubanga spp.</i>	Nagas	AS	1,3	2	1-2	2	1	—	1-2	1	1	5	2
<i>Durio spp.</i>	Durian	AS	3	3-4	2-3	2-3	1-2	—	2	—	3	3	1
<i>Dyera costulata</i>	Jelutong	AS	1	2	2	2	1	—	1	1	2	5	1
<i>Ekebergia rueppelliana</i>	Ekebergia	AF	1	3	2	—	1	—	3	2	1	3	1
<i>Endiandra palmerstonii</i>	Orientalwood	AS	1,2,3	4	—	—	—	—	—	—	3	4	—
<i>Endospermum spp.</i>	Gubas	AS	1	2	—	—	—	—	—	—	2	2	5
<i>Entandrophragma angolense</i>	Gedunohor	AF	3	3	3	2-3	3-4	2	3	1	3	3	4
<i>Entandrophragma candollei</i>	Kosipo	AF	1,3	4	3-4	4	4-5	3	—	2	5	4	3
<i>Entandrophragma cylindricum</i>	Sapele	AF	3	4	5	4	5	3	5	2	3	3	3
<i>Entandrophragma utile</i>	Utile	AF	3	4	4	3	4-5	2	4	2	3	2	3
<i>Enterolobium cyclocarpum</i>	Guanacaste	AM	1,3	2	1	1	1	—	2	1	1	2	—
<i>Enterolobium schomburgkii</i>	Timbauba	AM	1	6	6-7	6-7	7	5	7	—	2	4	1
<i>Eperua spp.</i>	Wallaba	AM	3	5	6	5	7	—	7	—	2	3	4
<i>Erythrophleum ivorense</i>	Missanda	AF	3	5	4-7	3-6	4-7	3	7	1	4	1	4
<i>Erythroxylum raniif</i>	Landa	AF	3	3	4	—	4	4	—	—	—	—	3
<i>Eschweilera spp.</i>	Manbarkiak	AM	1,3	7	4-7	3-7	3-7	4-7	4-7	—	4	5	4
<i>Eucalyptus deglupta</i>	Deglupta	AS	3	2-4	3	3	2	1	1	—	2	3	—
<i>Eucalyptus diversicolor</i>	Karri	AS	3	5	6	6	7	4	7	3	5	5	4
<i>Eucalyptus globulus</i>	Bluegum	AS	1	5-6	5-7	5-6	6-7	4-5	5-7	3	5	5	3
<i>Eucalyptus marginata</i>	Jarrah	AS	3	5	5	4	5	2-3	6	2	5	5	1
<i>Eucryphia cordifolia</i>	Ulmo	AM	3	3	3	3	3	—	—	—	3	1	4
<i>Eugenia spp.</i>	Kelat	AS	1,3	4-5	4-5	4-5	4-5	4-5	4-7	—	4	5	1
<i>Eusideroxylon zwageri</i>	Belian	AS	2,3,4	6	7	6	7	6-7	2-3	—	3	4	—
<i>Euxylophora paraensis</i>	Pau amarelo	AM	4	5	5	4	6	—	6	—	3	3	4
<i>Fagara macrophylla</i>	East African satinwood	AF	1,4	4-6	5-7	4	5-7	—	—	—	—	4	3
<i>Fagaropsis angolensis</i>	Mafu	AF	2,4	4	5	4	5	—	4	2	2	3	4
<i>Fagraea spp.</i>	Tembusu	AS	1	5-6	6-7	7	6-7	4	7	—	1	1	4
* <i>Fitzroya cupressoides</i>	Alerce	AM	3	2	2	2	2	—	2	—	2	2	—
<i>Flindersia spp.</i>	Queensland-maple	AS	1	3	3-4	3	3-4	3	3	3	1	2	4
<i>Gambeya africana</i>	Longui	AF	3,4	4	6	4-5	6-7	3	4	—	4	5	1

Table II-2--Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name/ 1/	Construction Heavy Light	Shakes and shingles	Joinery and mill- work	Floor- ing	Marine use	Musical instru- ments	Carvings wood veneer	Ply- wood	Decor- ative	Furniture cabinet	Turnery work	Tool handles	Reconstituted products	Vats (pulp, paper, PB)	Cooper- age tanks	Cross- ties	Boxes and crates	Speci- fic items
TROPICAL TIMBERS OF THE WORLD--continued																		
<i>Didelotia</i> <i>brevipaniculata</i>		X		X				X	X	X				X	X	X	X	X
<i>Didymopanax morototoni</i>				X				X	X	X				X				
<i>Dillenia</i> spp.																		
<i>Diospyros</i> spp. African ebony																		
<i>Diospyros</i> spp. E. Indian ebony																		
<i>Diploropis purpurea</i>	X				X													
<i>Dipterocarpus</i> spp.	X					X												
<i>Dipteryx odorata</i>	X					X												
<i>Distenonanthus</i> benhamianus																		
<i>Dracontomeum</i> spp.																		
<i>Dryobalanops</i> spp.																		
<i>Dubanga</i> spp.																		
<i>Durio</i> spp.																		
<i>Dyera</i> costulata			X															
<i>Ekebergia</i> rueppelliana								X	X	X								
<i>Endiandra</i> palmerstonii					X	X												
<i>Endospermum</i> spp.						X												
<i>Entandrophragma</i> angolense							X											
<i>Entandrophragma</i> candolieri							X	X										
<i>Entandrophragma</i> cylindricum							X	X										
<i>Entandrophragma</i> utile									X	X								
<i>Enterolobium</i> cyclocarpum										X								
<i>Enterolobium</i> schomburgkii	X										X							
<i>Eperua</i> spp.	X										X							
<i>Erythrophleum</i> ivorense	X							X	X			X						
<i>Erythroxylum</i> manti										X								
<i>Eschweilera</i> spp.	X							X	X			X						
<i>Eucalyptus</i> deglupta	X							X				X						
<i>Eucalyptus</i> diversicolor	X								X									
<i>Eucalyptus</i> globulus	X								X									
<i>Eucalyptus</i> marginata	X									X								
<i>Eucalyptus</i> cordifolia	X									X								
<i>Eugenia</i> spp.	X									X								
<i>Eusideroxylon</i> zwageri	X				X					X								
<i>Eurylophora</i> paraensis											X							
<i>Fagara</i> macrophylla												X						
<i>Fagara</i> angolensis												X						
<i>Fagraea</i> spp.	X											X						
* <i>Fitzroya</i> cupressoides	X											X						
<i>Flindersia</i> spp.													X					
<i>Gandiera</i> africana	X											X						

Table II-1.--Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species--continued

Scientific Name ^{1/}	Commercial Name	Geo-graphic region	Color	Density	Mechanical properties						Other properties			
					Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Move- ment	Shrinkage	Durability	Treatability	(heart- wood)
TROPICAL TIMBERS OF THE WORLD--continued														
Garcinia spp.	Kandis	AS	3	5-6	--	--	--	--	--	--	2	4	1-4	--
Genipa americana	Jagua	AM	1,3	4	4-5	3	3-4	3	5	--	3	4	5	1
Gluta spp.	Rengas	AS	3	4	3-5	5	--	--	5-7	--	1	2	3	3
Gmelina arborea	Gmelina	AS	1,3	3	2	1-2	1	--	2	1	1	2	3-4	3
Goniooma kamassi	Kamassi	AF	1	5	7	5	7	--	7	--	--	2	2	4
Gonostylius spp.	Ramin	AS	1	4	6	4	5-7	3	4	3	3	4	5	1
Gossweilerodendron balsamiferum	Agba	AF	1,3	2-3	2-3	1-2	1-3	1	2	1	1	2	5	--
Gossypiospermum praecox	West Indian boxwood	AM	1	5	--	--	--	--	--	--	--	--	3	3
Gouania glabra	Kopie	AM	3	5	5	4-5	5-7	2	6	--	3	3	3	4
Grevillea robusta	Silky-oak	AS	1	3	2-4	2	2	1	3	--	2	3	3	1
Guaiacum spp.	Lignumvitae	AM	4	6	--	7	3	7	--	--	2	2	1	4
Guarea cedrata	Guarea	AF	3	3	4-5	3	4-5	3	3	1	2	2	2-3	4
Guarea spp.	Cramantee	AM	3	3-4	3-5	3	3-4	2	3-4	1	2	3	2	4
Guibourtia arnoldiana	Mutende	AF	1,3	4	7	5-7	7	3-7	--	2	4	4	3	3
Guibourtia ehie	Obangkol	AF	1,2	5	5-6	5-6	5	5	--	4	4	5	3	3
Guibourtia spp.	Bubinga	AF	3	5	6-7	5-7	6-7	3-7	--	5	5	5	3	3
Helicostylis tomentosa	Leche perra	AM	2	5	6	6	7	5	7	--	4	4	5	4
Heritiera spp.	Mengkulang	AS	3	4	5	4	5	--	4	1	1	2	5	2
Hievea brasiliensis	Para rubber tree	AM	3	3	--	--	--	--	--	1	1	2	5	2
Hibiscus elatus	Blue mahoe	AM	4	4	--	--	--	--	--	--	1	1	--	--
Holopyxidium jarana	Jarana	AM	3	5-6	7	6	7	7	7	--	5	4	1	--
Homalium spp.	African homalium	AF	1	5	6	5-6	2	7	7	--	5	5	3	2
Homalium spp.	Burma lancewood	AS	1,3	5	5-6	5	5-7	--	6-7	--	1	2	2-3	3
Hopea spp.	Thingan	AS	1	4	5	4-5	5	--	3-4	1	2	2	2	4
Humiria balsamifera	Tauroniro	AM	1,3	5	6	5	5	2	5	--	5	5	1-2	--
Hura crepitans	Hura	AM	1	2	2	1-2	1	1	1	2	1	1	5	1
Hyeronima alchorneoides	Suradan	AM	3	4-5	5-6	5	5-6	3	6	--	4	5	1-3	2
Hymenaea courbaril	Courbaril	AM	3	5-6	6-7	4-7	6-7	4	7	--	3	4	1	4
Hymenolobium excelsum	Para-angelim	AM	1	4	4-6	4	5	4	6	--	3	3	1-2	2
Intsia bijuga	Metbau	AS	3	5	5-7	5-6	5-7	3-4	5-6	1	1	1	3	4
Irvingia gabonensis	Oba	AF	1	5	7	6	7	4	--	--	5	4	2	4
Iryanthera spp.	Kirikawa	AM	1,2,3	2-4	4-5	4-6	3-6	2	3	--	5	4	3-4	--
Isoberlinia scheffieri	Marika	AF	3	4-5	5	4	5	--	5	1	1	2	3	3
Jacaranda copaia	Copaia	AM	1	2	2-3	2-4	1	1	1	--	3	4	1	1
Juglans spp.	Mogal	AM	4	3	2	2	2	2	2	--	1	2	--	4

Table II-2.--Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name ^{1/}	Construction Heavy Light	Shakes and shingles	Joinery and mill- work	Floor ing	Marine use	Musical instruments	Carvings	Ply- wood	Furniture and cabinet work	Tool handles	Turnery cabinet work	Reconstituted products (pulp, paper, PB, FB)	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																	
<i>Garcinia</i> spp.				X									X				
<i>Genipa americana</i>				X			X		X				X				
<i>Gluta</i> spp.				X			X	X	X				X				
<i>Gmelina arborea</i>							X	X	X				X				
<i>Conicoma kamassii</i>													X				
<i>Gonystylus</i> spp.				X	X			X					X				
<i>Gossierodendron balasaniferrum</i>			X		X	X							X				
<i>Cespedispermum praecox</i>					X	X		X					X				
<i>Goupi glabra</i>			X		X	X							X				
<i>Grevillea robusta</i>						X							X				
<i>Guaiacum</i> spp.					X	X							X				
<i>Guarea cedrata</i>													X				
<i>Guarea</i> spp.								X					X				
<i>Guibourtia arnoldiana</i>						X							X				
<i>Guibourtia ehie</i>							X						X				
<i>Guibourtia</i> spp.													X				
<i>Helicostylis tonentosa</i>			X										X				
<i>Heritiera</i> spp.					X	X							X				
<i>Hevea brasiliensis</i>			X										X				
<i>Hibiscus elatus</i>						X							X				
<i>Holopyxidium jarana</i>								X					X				
<i>Homalanthus</i> spp. African hom.														X			
<i>Homalanthus</i> spp. Burma Lancewood														X			
<i>Hopea</i> spp.														X			
<i>Humiria balasmifera</i>															X		
<i>Hura crepitans</i>								X						X			
<i>Hyeronima alchorneoides</i>									X						X		
<i>Hymenaea courbaril</i>										X					X		
<i>Hymenolobium excelsum</i>											X				X		
<i>Instia biligia</i>											X				X		
<i>Irvingia gabonensis</i>											X				X		
<i>Iryanthera</i> spp.												X			X		
<i>Isoberlinia schaffneri</i>												X			X		
<i>Jacaranda copaia</i>												X			X		
<i>Juglans</i> spp.												X			X		

Table II-1.—Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species—continued

Scientific Name ^{1/}	Commercial Name	Geo-graphic region	Color	Density	Mechanical properties				Other properties				
					Bending strength	Stiffness strength	Crushing strength	Toughness	Hardness	Movement	Shrinkage Rad.	Durability Tan.	Treatability (heartwood)
TROPICAL TIMBERS OF THE WORLD—continued													
<i>*Juniperus procera</i>	Muwa African pencil cedar	AF AF	3 3	5-6 3	7 2	5 2	7 2	— —	7 2	2 2	3 2	2 2	2 4
<i>Khaya grandifoliola</i>	African mahogany	AF AF	3 3	4 3	4 3	4 3	2-3 2	4 3	1 1	3 3	3 3	3 3	4 4
<i>Khaya ivorensis</i>	African mahogany	AF AF	3 2	6 7	7 7	7 7	6 6	— —	— —	5 5	5 5	1 1	3 3
<i>Klainedoxa gabonensis</i>	Eveaus	AF											
<i>Koompassia malaccensis</i>	Kempas	AS	3	5	6	6	6	— —	6 1	4 3	3 3	3 3	1 1
<i>Koorderiodendron pinnatum</i>	Ranggu Pyinma	AS AS	3 3	5 4	7 4	5 3	— —	6 3	1 4	5 5	3 3	3 3	4 4
<i>Lagerstroemia spp.</i>	Sapucaria	AM	3	4-6	4-7	4-7	4-5	3 3	— —	3 3	3 3	3 3	4 4
<i>Lecythis spp.</i>	Marishballi	AM	1,2	5-6	7	5-7	7	6-7	7 7	— —	4 4	3 3	1 1
<i>Licania spp.</i>	Kaneelhart	AM	1,3	5-6	7	7	7	5 5	7 7	— —	5 5	4 4	3 3
<i>Litsea spp.</i>	Medang	AS	3	2-4	3-4	2-4	2-4	2 2	2 2	— —	2 2	3 3	2-5 2-5
<i>Lonchocarpus spp.</i>	Black cabbage-bark	AM	1,3	4-5	6-7	6-7	4-7	6 6	7 7	2 2	4 4	2 2	2-4 3
<i>Lophira alata</i>	Ekki	AF	3,4	6	7	6-7	7	7	7 7	2 2	5 5	1 1	4 4
<i>Lophopetalum spp.</i>	Perupok	AS	1,3	3	2-3	2	2	2	— —	— —	2 2	2 2	5 5
<i>Lovoa trichilioides</i>	African-walnut	AF	1	3	3	3	3	3	2 2	— —	2 2	3 3	4 4
<i>Luehea spp.</i>	Estrifeiro	AM	1,3	3-4	4	4	4	3 3	2 2	— —	2 2	3 3	1 1
<i>Lysiloma spp.</i>	Sabici	AM	1,4	4	4	4	— —	5 4	— —	— —	1 1	3 3	— —
<i>Machaerium spp.</i>	Caviruna	AM	1,4	5	5	— —	4 4	4-5	— —	— —	1 1	2 2	3 3
<i>Nachilus spp.</i>	Machilus	AS	1,3	3	2	2	1	— —	2 2	— —	1 1	2 2	— —
<i>Maesopsis eminii</i>	Mustizi	AF	1,4	3	2-3	2-3	2-3	— —	2 2	1 1	2 2	2 2	5 5
<i>Magnolia spp.</i>	Magnolia	AM	4	3-4	3-4	3-4	4	2 2	— —	3 3	5 5	1 1	3 3
<i>Mammea africana</i>	Oboto	AS	1,2,3	3-4	4-5	6-7	6-7	1-4	— —	3 3	5 5	2 2	2 2
<i>Hangifera spp.</i>	Mango	AM	3	6	7	7	7	5 5	— —	5 5	1 1	4 4	1 1
<i>Manilkara bidentata</i>	Bulletwood	AM											
<i>Mansonnia altissima</i>	Mansonnia	AF	1,4	3-4	4-5	4-5	3-5	2-5	4 2	— —	3 3	1 1	4 4
<i>Maytenus spp.</i>	Carne d'anta	AM	3	4-5	6	5	7	2 7	— —	— —	3 3	4 4	1 1
<i>Melaleuca quinquenervia</i>	Broad-leaved tea-tree	AS	3	4-5	— —	— —	— —	— —	— —	— —	3 3	4 4	— —
<i>Nelia acedarach</i>	Persian lilac	AS	3	3	5	2	4	5 5	— —	— —	4 4	4 4	2 2
<i>Nesua ferrea</i>	Gangaw	AS	3	6	7	6	7	4 7	— —	— —	4 4	4 4	— —
<i>Metrosideros collina</i>	Ohia	AS	3	5	6	5	4	7	3 3	— —	5 5	5 5	4 4
<i>Michelia spp.</i>	Champaca	AS	1	3	2-3	2-3	2-3	— —	2 2	— —	2 2	2 2	3 3
<i>Microberlinia brazzavillensis</i>	Zebrawood	AF	1,4	5	5-7	5	5-7	7	— —	— —	5 5	5 5	2 2
<i>Micropholis spp.</i>	Grumixava	AM	1	4-5	4-7	7	3-6	2 2	5 5	— —	4 4	4 4	3 3
<i>Milletia spp.</i>	Panga panga	AF	2,4	5	5-7	4-6	6-7	4-7	5 5	— —	1 1	2 2	1 1
<i>Mitragyna ciliata</i>	Abura	AF	1,3	3	3	2-3	2-3	— —	2 2	— —	1 1	3 3	4 4
<i>Monopeltanthus heitzii</i>	Adoung	AF	3	4	2	3	3	— —	— —	— —	3 3	3 3	3 3
<i>Mora excelsa</i>	Mora	AM	3	5-6	7	6	7	7	— —	— —	5 5	5 5	1-2 1-2
<i>Morus mesozygia</i>	Difou	AF	1	5	7	5	7	3 3	— —	— —	1 1	2 2	4 4
<i>Musanga cecropioides</i>	African cork-wood	AF	1	1-2	1-2	1-2	1-2	1-2	1 1	— —	— —	1 1	5 5

Table II-2.-Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name ^{1/}	<u>Construction</u>	Shakes and light shingles	Joinery and mill- work	Floor- ing	Musical instru- ments	Carvings use	Ply- wood	Decor- ative veneer	Furniture and cabinet work	Turnery handles	Tool	Reconstituted products (pulp, paper, PB, FB)	Vara and age	Cooper- tanks	Boxes and crates	Cross- ties	Specialty items
<hr/>																	
<i>Julbernardia globiflora</i>	X			X									X			X	X
* <i>Juniperus procera</i>																	
<i>Khaya grandifolia</i>				X		X											
<i>Khaya ivorensis</i>				X													
<i>Kleiniodoxa gabonensis</i>	X				X									X			X
<i>Koompassia malaccensis</i>	X																
<i>Koordersiodendron</i>																	
<i>Pinatum</i>																	
<i>Lagerstroemia</i> spp.	X			X		X											
<i>Tectaria</i> spp.	X				X												
<i>Licania</i> spp.	X					X											
<i>Licaria</i> spp.																	
<i>Lisesse</i> spp.	X				X												
<i>Lonchocarpus</i> spp.	X					X											
<i>Lophira alata</i>	X					X											
<i>Lophopetalum</i> spp.	X																
<i>Lorosia trichilioides</i>																	
<i>Luehea</i> spp.																	
<i>Lysiloma</i> spp.	X					X											
<i>Machaerium</i> spp.																	
<i>Machilus</i> spp.	X																
<i>Maeospisia emarginata</i>	X																
<i>Magnolia</i> spp.	X																
<i>Mammea americana</i>																	
<i>Mangifera</i> spp.	X																
<i>Manilkara</i> <i>identata</i>	X																
<i>Mansonia altissima</i>																	
<i>Maytenus</i> spp.	X																
<i>Melaleuca quinquenervia</i>																	
<i>Melia azedarach</i>																	
<i>Mesua ferrea</i>	X																
<i>Metrodorea collina</i>																	
<i>Micheletia</i> spp.	X																
<i>Microberlinia</i> <i>braziliensis</i>																	
<i>Micropholis</i> spp.	X																
<i>Milletia</i> spp.	X																
<i>Mitrastigma ciliata</i>																	
<i>Monopeltanthus heitzii</i>	X																
<i>Mora excelsa</i>																	
<i>Morus megalocarpa</i>																	
<i>Musanga cecropioides</i>																	

TROPICAL TIMBERS OF THE WORLD--continued

Table II-1.—Ooded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species—continued

Scientific	Name ^{1/}	Commercial	Geo-graphic region	Color	Density	Mechanical properties				Other properties				
						Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Mov- ement	Shrinkage	Durability	Treatability (heart- wood)
TROPICAL TIMBERS OF THE WORLD—continued														
<i>Moristicica</i> spp.	darah darah	AS	1,3	3-4	—	—	3	—	3	—	3	3	5	1
<i>Myroxylon</i> balsamum	Balsamo	AM	3	5-6	6-7	5	6-7	5	5	2	2	2	1	4
<i>Nauclea diderrichii</i>	Opepe	AF	1	4	4-5	4	5-6	3	5	1	3	4	1	2
<i>Nectandra</i> spp.	Canelo	AM	4	3-4	3-5	3	3-5	2	3	—	2	2	2-4	4
<i>Nesogordonia</i> la														
<i>papaverifera</i>	Danta	AF	3	4-5	6	3-4	6	5	7	2	4	4	2	4
<i>Nothofagus</i> spp.	Raulí Coigüe	AM	3	3	3-5	3-4	3-5	—	3	1	2	3	2-4	2
<i>Nothofagus</i> spp.	Tasmanian-myrtle	AS	3	3-4	3-5	3-4	2-5	2-3	4	—	2	2	2-4	3
<i>Ochroma pyramidalis</i>	Balsa	AM	1,3	1	1	1	1	—	1	1	2	3	5	3
<i>Ocotea rodiae</i>	Demetara green- heart	AM	4	6	7	7	7	—	7	2	5	5	1	4
<i>Ocotea rubra</i>	Determa	AM	3	4	3-4	4	2-3	1-2	2	—	2	3	1-2	4
<i>Ocotea usambarensis</i>	East African camphorwood	AF	1	3	3-4	3	3-4	—	3	1	2	2	1	4
<i>Ocotea sumatrana</i>	Binuang	AS	1,3	2	2	1-2	1-2	1	1	—	2	2	5	2
<i>Ocotea usambarensis</i>	Onzang	AF	1	2	1	1	1	—	7	3	5	5	3-4	2
<i>Ocotea usambarensis</i>	East African olive	AF	4	5	7	6	7	—	7	3	5	5	—	
<i>Ocotea usambarensis</i>	Angueuk	AF	1	5	4-7	3-5	5-7	1-2	—	—	3	5	2	3
<i>Ormosia</i> spp.	Baracara	AM	1,3	3-5	4-6	3-5	3-6	3	3-5	—	2	3	5	2
<i>Osandra lanceolata</i>	West Indian lancewood	AM	1	6	7	6	—	—	—	—	5	5	4	—
<i>Oxystigma oxyphyllum</i>	Tchitola	AF	3	4	4-5	3	4	2	4	1	4	5	2-4	1
<i>Palaeolum</i> spp.	Nyatoh	AS	1,4	3-4	3-4	3-4	1-4	—	3-4	—	3	3	4	4
<i>Parashorea</i> spp.	White seraya	AS	1,3	3	3-4	3-4	3-4	3	2-3	1	1	3	3-4	4
<i>Paratecoma</i> peroba	White peroba	AM	3,4	4	5	3	3-5	5	5	—	2	3	1	3
<i>Parinari excelsa</i>	Sougue	AF	3	4-5	5-7	4-5	6-7	3	6	—	5	5	4	3
<i>Parinari</i> spp.	Burada	AM	1,3	5	6-7	6	6-7	3	6	—	4	5	3-5	1
<i>Peltogyne</i> spp.	Purpleheart	AM	4	5-6	6-7	5-7	3-7	6-7	1	2	2	2	1	4
<i>Pentace</i> spp.	Thitka	AS	1,3	4	3	3-4	3-4	—	3-4	—	2	2	—	3
<i>Pentaclea</i> spp.														
<i>Pericopsis elata</i>	White lauan	AS	1,3	3-5	3-6	3	3-6	2	2	—	3	3	2-4	2
<i>Pericopsis elata</i>	Afrotmosia	AF	1,2	4	3-6	3-4	5-6	2	5	1	2	2	1	4
<i>Persea</i> spp.	Lingue	AM	3	3-4	3-4	3	3	3	—	3	4	4	4	3
<i>Phoebe porosa</i>	Imbuia	AM	2,4	4	4	3	3	2	3	—	1	2	2	—
<i>Phyllostylon brasiliensis</i>	San Domingo- boxwood	AM	1	5	—	—	—	—	—	—	—	—	—	—
* <i>Pinus caribaea</i>	Caribbean pine	AM	1,3	2-5	2-5	1-5	4-5	5	4	—	5	3	3	2
* <i>Pinus insularis</i>	Benguet pine	AS	1,3	3	3-5	3-4	3-4	2	1-2	—	3	3	5	2
* <i>Pinus merkusii</i>	Merkus pine	AS	1	4	6	5	5	2	2	—	—	4	—	—
* <i>Pinus occarpa</i>	Ocote Pine	AM	3	4	5	5	4	2	3	—	3	3	3	3
* <i>Pinus patula</i>	Patula pine	AM	1	3	4	2-4	2-4	—	—	—	3	3	5	1

1/ *Pinus caribaea
*Pinus insularis
*Pinus merkusii
*Pinus occarpa
*Pinus patula

Table II-2.--Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name /	Construction Heavy	Shakes Light	and shingles	Floor- ing	Joinery use	Musical instruments	Ply- wood	Decor- ative veneer	Furniture and cabinet work	Tool handles	Reconstituted products (pulp, paper, PB, FB)	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																
<i>Myristica</i> spp.	X			X						X						
<i>Myroxylon balsamum</i>				X	X					X						X
<i>Nauclea diderrichii</i>	X	X			X	X				X						X
<i>Nectandra</i> spp.				X	X					X						
<i>Neogordonia</i>																
<i>Papaverifera</i>	X	X			X	X				X						
<i>Nothofagus</i> spp. <i>Rauli Coigue</i>				X	X					X						
<i>Nothofagus</i> spp. <i>Tasmanian-myrtle</i>				X	X					X						X
<i>Ochroma</i> <i>Pyramidalis</i>																X
<i>Ocotea rodiae</i>	X	X			X	X				X						
<i>Ocotea rubra</i>				X	X					X						X
<i>Ocotea usambarensis</i>																
<i>Ocotea sumatrana</i>																
<i>Odontidea</i> spp.																
<i>Olea hochstetteri</i>																
<i>Ongokea gore</i>																
<i>Ormosia</i> spp.				X						X						
<i>Oxandra lanceolata</i>																
<i>Paratigia oxyphyllum</i>					X					X						X
<i>Palauium</i> spp.						X				X						
<i>Parashorea</i> spp.						X				X						
<i>Paratecoma petoba</i>						X				X						
<i>Parinari excelsa</i>							X			X						
<i>Parinari</i> spp.								X		X						
<i>Peltogyne</i> spp.									X							
<i>Pentacle</i> spp.										X						
<i>Pentacle</i> spp.											X					
<i>Pericopsis elata</i>												X				
<i>Pterea</i> spp.													X			
<i>Phoebe porosa</i>														X		
<i>Phyllostylon brasiliensis</i>															X	
* <i>Pinus caribaea</i>	X	X														X
* <i>Pinus insularis</i>																X
* <i>Pinus mekistii</i>																X
* <i>Pinus occidentalis</i>	X	X														X
* <i>Pinus patula</i>	X	X														X

Table II-1.—Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species--continued

Scientific Name/ 1/	Commercial	Geo- graphic region	Color	Density	Mechanical properties				Other properties			
					Bending strength	Stiff- ness	Crushing strength	Tough- ness	Moving- ment	Shrinkage Rad.	Durability Tan.	Treatability (heart- wood)
TROPICAL TIMBERS OF THE WORLD--continued												
<i>Piptadenia pittieri</i>	Carbonero	AM	1,3	4	5-7	4-5	5-6	--	5	--	3	4
<i>Piptadeniastrum africanum</i>	Dahoma	AF	1	4	5	4	4-5	4	5	2	2	3
<i>Piratinaea guianensis</i>	Letterwood	AM	3,4	6	--	--	--	--	--	--	--	--
<i>Pithecellobium saman</i>	Saman	AM	2,4	3	2	2	1	1	3	--	1	1
<i>Planchonia spp.</i>	Putat paya	AS	3,4	4	4-5	3-4	4	2-3	4	2	5	4
<i>Platymiscium spp.</i>	Trebol	AM	3,4	5-6	5-7	6-7	3	6-7	--	1	1	4
* <i>Podocarpus spp.</i>	Podocarp	AM	1	2-4	2-5	2-4	1-3	1	2	1	2	3
* <i>Podocarpus spp.</i>	Totara	AS	1,3	2-3	2-3	2-4	1	1-3	--	2	2	3
* <i>Podocarpus spp.</i>	Podo	AF	1	3	3	2	3	--	3	1	2	2
<i>Poga oleosa</i>	Ovoga	AF	3	2	2	2	1-2	--	--	1	3	5
<i>Pometia spp.</i>	Kasai	AS	3	4	4-5	3-4	4-5	2	4-6	--	4	3
<i>Poulsenia armata</i>	Mastate	AM	1	2	1	--	--	1	--	2	3	2
<i>Pradosia spp.</i>	Chupon	AM	1,3	5	6	5	4	6	--	3	5	--
<i>Priacaria copaifera</i>	Cativo	AM	1,2	2-3	2	2	1	2	--	1	2	--
<i>Protium spp.</i>	Kurokai	AM	1,3	3-4	3-5	3-4	3-5	3	2-4	--	3	5
<i>Pseudosamanea guachapele</i>	Guachapele	AM	1	4	3	2	3	2	--	1	1	1-2
<i>Pseudosindora palustris</i>	Sepetir	AS	2,3	4	4-6	4	3-5	--	4-5	1	2	4
<i>Pterocarpus angolensis</i>	Muninga	AF	1,2,3	3-4	4	2	4	--	5	1	1	2-3
<i>Pterocarpus dalbergioides</i>	Andaman padauk	AS	3	4	5	3	6	--	5	--	2	3
<i>Pterocarpus indicus</i>	Narra	AS	1,3	3-4	4	3	4-5	2-4	3-4	1	1	--
<i>Pterocarpus macrocarpus</i>	Burma padauk	AS	3	5	7	4	7	--	7	--	2	1
<i>Pterocarpus soyauxii</i>	African padauk	AF	3-4	4-5	4-6	3-4	4-5	2-4	--	1	2	3
<i>Pterocarpus spp.</i>	Sangre	AM	1	2-4	2-5	2-4	2-4	4	1-4	--	2	1
<i>Pterogyne nitens</i>	Amendoim	AM	3	5	--	4	5	--	--	2	3	--
<i>Pterogyta spp.</i>	Pterygota	AF	1	3-4	3-5	3-5	3-5	3-4	3	2	4	2
<i>Pycnanthus angolensis</i>	Ilobama	AF	1,3	3	3	2	2	--	--	3	4	5
<i>Pygeum africanum</i>	Mueri	AF	3	4	5	3	5	--	6	--	5	3
<i>Qualea spp.</i>	Mandioca	AM	3	3-4	5-6	5-6	4-7	3	3-6	--	3	1-2
<i>Quercus spp.</i>	Roble	AM	1,3	4-6	5-7	6	--	5	5-7	--	5	2
<i>Rheedia spp.</i>	Pacuri	AM	1,3	5	6	--	5	6	--	3	5	2-4
<i>Rhizophora mangle</i>	Jangle Colorado	AM	3	6	7	6-7	7	--	7	--	4	2
<i>Ricinodendron heudelotii</i>	Erimado	AF	1	1	1	1	1	1	--	--	1	1
<i>Santalum album</i>	Sandalwood	AS	1,2,3	5	5	--	4	--	5	--	1	--
<i>Sapindus spp.</i>	Lechero	AM	1	3	3	2-3	1	2	--	2	3	--
<i>Schima spp.</i>	Needlewood	AS	3	4	4	4	4	4	--	3	4	3

Table II-2.-Uses for various tropical timbers of the world, compared to eight U.S. Species--continued

Name ^{1/}	Construction	Shakes and shingles	Joinery and mill- work	Floor- ing	Marine use	Musical instru- ments	Carvings and veneer	Ply- wood	Decor- ative	Furniture and cabinet work	Turnery handles	Tool handles	Reconstituted products (pulp, paper, PB, FB)	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																		
<i>Piptadenia pittieri</i>	X			X														X
<i>Piptadeniastrum</i>	X			X														X
<i>Pirainera guianensis</i>																		
<i>Pithecellobium saman</i>				X														
<i>Planchonia</i> spp.	X			X														X
<i>Platymiscium</i> spp.																		
* <i>Podocarpus</i> spp. <i>Podocarp</i>	X			X				X				X						X
* <i>Podocarpus</i> spp. <i>Totara</i>	X			X			X				X							
* <i>Podocarpus</i> spp. <i>Podo</i>	X			X			X				X							
<i>Poga oleosa</i>																		X
<i>Pomaria</i> spp.	X			X			X				X							
<i>Poulsenia armata</i>	X			X			X				X							
<i>Pradoa</i> spp.	X			X			X				X							
<i>Prionia copaifera</i>																		
<i>Protium</i> spp.	X			X			X				X							X
<i>Pseudosamanea</i>																		X
<i>Guachapale</i>	X	X		X			X				X							
<i>Pseudosindora palustris</i>				X	X		X				X							
<i>Pterocarpus angolensis</i>				X	X		X				X							
<i>Pterocarpus</i> dabbergioides				X	X		X				X							
<i>Pterocarpus indicus</i>				X	X		X				X							X
<i>Pterocarpus macrocarpus</i>				X	X		X				X							
<i>Pterocarpus soyauxii</i>				X	X		X				X							
<i>Pterocarpus</i> spp. <i>Pterogyne nitens</i>	X			X			X				X							
<i>Pterogyne</i> spp.																		
<i>Pycnanthus angolensis</i>				X			X				X							
<i>Pygmaeum africanum</i>	X			X			X				X							
<i>Qualea</i> spp.	X	X		X			X				X							X
<i>Rheedia</i> spp.	X			X			X				X							X
<i>Rhizophora mangle</i>	X																	X
<i>Ricinodendron heudelotii</i>																		
<i>Santalum album</i>																		
<i>Sesbania</i> spp.	X			X			X				X							X

Table II-1.--Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species--continued

Scientific Name ^{1/}	Commercial name	Geo- graphic region	Color	Density	Mechanical properties				Other properties			
					Bending strength	Stiff- ness	Crushing strength	Tough- ness	Hard- ness	Mov- ement	Shrinkage	Durability
TROPICAL TIMBERS OF THE WORLD--continued												
<i>Schinopsis</i> spp.	Quebracho Djedoe	AM AM	3 2,3	6 3	4-7 3-4	4 5	5 2-3	-- 3	-- 2	-- 3	-- 4	-- 2-4
<i>Sclerodermum</i> spp.												-- 3
<i>Sciodocarpus</i> borneensis	Kulim	AS AF	3 1	5 4	4 5	5 5	-- 2-4	4 3	3 2	3 1	3 1	3 3
<i>Sciotellia coriacea</i>	Odoko	AF	3	3	2-4	1-3	1	--	2 1	2 1	5 5	2 2
<i>Seyphoccephalium ochocoa</i>	Zorro	AF										
<i>Shorea</i> spp.	Balau group	AS	3	5	6-7	5	6	5 5	2 2	5 5	4 4	4 4
<i>Shorea</i> spp.	Dark red meranti	AS	2,3	4	3-4	3	2-4	4 2-3	1 1	2 2	3 3	3 3
<i>Shorea</i> spp.	Light red meranti	AS	1,2,3	2-3	3-4	3-4	2-3	2 2	1 1	3 3	4 4	3-4
<i>Shorea</i> spp.	White meranti	AS	1	3-4	4	3	3	-- 3-4	-- 2	3 3	4 4	2-4
<i>Shorea</i> spp.	Yellow meranti	AS	1	3	4	3	4	-- 2	1 2	4 4	4 4	4 4
<i>Sickkingia</i> spp.	Araiba	AM	2	3-4	4	--	3	2 1	-- 1	1 4	3 3	1 1
<i>Samarouba</i> amara	Samarouba	AM	1	2	2	2	1	-- 1	-- 1	1 2	5 5	1 1
<i>Somneria</i> spp.	Perepat	AS	1,2	3-4	3	2	3	-- 1	-- 1	1 2	3 3	-- --
<i>Spondias</i> mombin	Jobo	AM	1	2	2	2	1-3	1 1	1-2 1	1 1	5 5	1 1
<i>Staudtia</i> stipitata	Niove	AF	1,3	5	7	5	7	2-4	-- 1	4 4	3 3	1 4
<i>Sterculia apetala</i>	Chicha	All	1,3	2	1-2	1	1	1 1	1-2 2	2 2	4 4	1-2 1-2
<i>Sterculia oblonga</i>	Yellow sterculia	AF	1	4	5	4	6	4 4	2 2	3 3	5 5	4 4
<i>Sterculia pruriens</i>	Sterculia	AM	1	3	3	3-4	3-5	2 2	3 3	3 3	5 5	2 2
<i>Sterculia rhinopetalia</i>	Brown sterculia	AF	3	4	7	4	6	4 6	3 3	5 5	3 3	4 4
<i>Strombosia glaucescens</i>												
var. <i>Lucida</i>	Afina	AF	1,3	6	7	5	7	--	--	5 5	1 1	4 4
<i>Swartzia fistulifoliae</i>	Dina	AF	1,2,3	6	7	5-6	7	5	--	3 3	2 2	1 1
<i>Swartzia</i> spp. (Lapacho group)	Wanara	AM	2,3,4	6	7	6-7	7	5 7	3 3	2 2	1 1	-- --
<i>Swietenia macrophylla</i>	Honduras	AM	3	3-5	3	2-3	3	1	2-3 1	2 2	1 1	2 4
<i>Swintonia</i> spp.	Mahogany	AS	1,3	4	3-5	4-5	2-4	--	3-4 4	--	2 2	4 4
<i>Sympomnia globulifera</i>	Merbau	AM,AF	1,4	4	5-6	5	5-6	3 4	-- 4	4 5	2 2	1-2 1-2
<i>Sympomnia globulifera</i>	Manni											3 3
<i>Tabea</i> spp. (White-cedar group)	Turpentine	AS	3	5	7	5	7	2-4 4-5	--	5 5	1 1	-- --
<i>Tabea</i> spp. (Roble group)	Ipe	AM	4	6	7	7	7	7 7	1 1	5 4	1 1	4 4
<i>Tarrietia utilis</i>	Bobile	AM	1	3-4	4	3	3-4	2 3	--	2 2	2 2	1-3 3
<i>Tectona grandis</i>	White-cedar	AM	1,3	4	5-6	4-5	5	2 4	--	3 3	4 4	1 1
	Jiangon	AF	3	3-4	4-5	3-4	4-5	3 3	3-4 2	3 3	2 2	4 4
<i>Terminalia amazonica</i>	Teak	AS	1,2	4	4-5	2-3	3-5	2 3	3-4 1	1 1	2 2	1 1
<i>Terminalia bialata</i>	Mangusta	AM	1,3	4-5	6-7	5-7	3	5-7	--	5 4	1-3 1-3	4 4
<i>Terminalia catappa</i>	White chuglan	AS	1,4	4	4	3	--	4	--	4 3	3-4 3-4	2 2
<i>Terminalia</i> spp.	Indian almond wood	AS	3	3-4	--	--	--	3 2	5 5	2 2
<i>Terminalia ivorensis</i>	Indigo	AF	1,3	3	3	3	3	2 3	1 2	2 2	2 2	4 4

Table II-2.—Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name ^{1/}	Construction	Shakes Heavy	Light	Joinery and mill- work	Floor- ing	Marine use	Musical instru- ments	Carvings	Ply- wood	Decor- ative veneer	Furniture and cabinet work	Tool handles	Turnery handles	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items	
TROPICAL TIMBERS OF THE WORLD--continued																			
<i>Schinopia</i> spp.	X	X										X							
<i>Sclerolobium</i> spp.																			
<i>Sgorodocarpus</i> bornensis	X	X																	
<i>Scotellia coriacea</i>																			
<i>Syphocephalium ochracea</i>																			
<i>Shorea</i> spp. Balau group	X				X														
<i>Shorea</i> spp. Dark red meranti group					X	X													
<i>Shorea</i> spp. Light red meranti "					X	X													
<i>Shorea</i> spp. White meranti group	X				X														
<i>Shorea</i> spp. Yellow meranti group	X				X														
<i>Sicklingia</i> spp.	X				X														
<i>Simarouba amara</i>					X														
<i>Sonneratia</i> spp.	X				X														
<i>Spondias mombin</i>					X														
<i>Staudia atipitata</i>					X														
<i>Sterculia apetala</i>																			
<i>Sterculia oblonga</i>	X				X														
<i>Sterculia pruriens</i>	X				X														
<i>Sterculia rhinopetalala</i>	X				X														
<i>Strombosia glaucescens</i> var. <i>lucida</i>					X														
<i>Swartzia fistuloides</i>									X										
<i>Swartzia</i> spp.						X			X										
<i>Swietenia macrophylla</i>						X			X										
<i>Sympodium globulifera</i>	X				X				X										
<i>Syncarpia glomulifera</i>	X								X										
<i>Tabebuia</i> spp. (Lapacho group)	X				X				X										
<i>Tabebuia</i> spp. (Roble group)					X				X										
<i>Tabebuia</i> spp. (White- cedar group)					X				X										
<i>Tarrietia utilis</i>					X				X										
<i>Tectona grandis</i>					X				X										
<i>Terminalia amazonica</i>	X				X				X										
<i>Terminalia bialata</i>					X				X										
<i>Terminalia catappa</i>	X				X				X										
<i>Terminalia ivorensis</i>	X				X				X										

Table II-1.--Coded physical and mechanical properties of various timbers of the world, compared to eight sample U.S. species--continued

Scientific name ^{1/}	Name ^{1/}		Geo- graphic region		Mechanical properties		Other properties					
	Commercial	Afara	Color	Density	Bending strength	Stiff- ness strength	Crushing strength	Tough- ness	Moving- ment	Shrinkage Rad.	Durability Tan.	Treatability (heartwood)
TROPICAL TIMBERS OF THE WORLD--continued												
<i>Terminalia procera</i>	White bombay	AS	1,2	3-4	4	3	4	--	3	1	2	4
<i>Terminalia superba</i>	Afara	AF	1,4	3	3-4	3	2-3	1	--	1	3	2
<i>Terminalia tomentosa</i>												4
complex	Indian laurel	AS	1,2, ⁴	5	4-5	3-4	4-5	--	7	--	3	3
	Izombé	AF	3,4	4	4-5	3-4	4-6	1	--	2	2	3
<i>Testulea gabonensis</i>												3
<i>Tetraberlinia tubmaniana</i>	Ekop	AF	3	4	5	5	6	--	--	4	5	2
<i>Tetragastris</i> spp.	Sali	AM	4	4-6	5-6	4-5	5-6	4	6-7	--	3	4
<i>Tetrameles nudiflora</i>	Thitpok	AS	1	2	--	--	--	--	--	--	1-2	4
<i>Tetramerista glabra</i>	Punah	AS	1,3	4	--	--	--	--	--	--	5	--
<i>Makoré</i>	Makoré	AF	3	4	4-5	3	4-6	1	4	5	5	3
<i>Tieghemella heckelii</i>	Long John	AM	1,3	3-4	4-6	4	4	2-3	3-6	--	2	4
<i>Triplaris</i> spp.												3
<i>Triplochiton scleroxylon</i>	Obeche	AF	1	2	2	1	1	1	1	2	2	3
<i>Tristania</i> spp.	Brush box	AS	3	5-6	6-7	5-6	6-7	4-7	6-7	--	4	2
<i>Trophis</i> spp.	Ramón	AM	1,2	3-4	3	--	2	1	2	--	5	4
<i>Turreantius africanus</i>	Avodiré	AF	1	3	4-6	3-4	3-5	2-3	3	1	3	1
<i>Upaca</i> spp.	Sugar plum	AF	3	4-5	5-6	3-6	4	2-4	--	4	5	4
<i>Upuna borneensis</i>	Upun batu	AS	2	6	--	--	--	--	--	1	1	2
<i>Vatarea</i> spp.	Bitter angelim	All	4	3-6	3-5	2-3	2-3	1-2	3-5	--	2	3
<i>Virola</i> spp.	Banak	AM	1,3	2-4	2-3	2-4	1-2	1	1-2	--	3	2-3
<i>Vitex</i>	Vitex	AF	1	2-3	1	1	1	1	2	1	2	1
<i>Vitex</i> spp.	Fiddlewood	AM	1,4	4	4-5	3-5	4-7	2	4	--	2	4
<i>Vitex</i> spp.												4
<i>Vochysia</i> spp.	Molave	AS	1,3, ⁴	4-5	5-6	3-4	3-6	3	4	1-2	3	--
<i>Vouacapoua americana</i>	Yemeri	AM	1,3	2-4	2-3	2-3	2	1	1-2	--	2	1
<i>Wallaceodendron celebicum</i>	Wacapou	AM	2,3	5-6	7	5	7	4	6	--	3	4
* <i>Widdringtonia whytei</i>	Banuyo	AS	1	4	--	--	--	--	--	--	--	--
<i>Xyilia xylocarpa</i>	Mlanje cedar	AF	1	3	--	--	--	--	--	--	1	--
<i>Zanthoxylum flavum</i>	Pyinkado	AS	3	5-6	5-7	4-5	5-7	4	7	2	3	1
	West Indian satinwood	AM	1	5	--	--	--	--	--	--	4	4

Table II-2. -Uses for various tropical timbers of the world, compared to eight U.S. species--continued

Name ^{1/}	Construction	Shakes and shingles	Joinery and mill- work	Floor- ing	Musical use	Ply- wood	Decor- ative veneer	Furniture and cabinet work	Turnery handles	Tool handles	Reconstituted products (pulp, paper, PB, FB)	Vats and tanks	Cooper- age	Boxes and crates	Cross- ties	Specialty items
TROPICAL TIMBERS OF THE WORLD--continued																
<i>Terminalia procera</i>	X					X		X								
<i>Terminalia superba</i>	X					X		X								
<i>Terminalia tomentosa</i> complex				X												
<i>Tectula gabonensis</i>				X				X								
<i>Tetraclinis</i> <i>tuberculata</i>								X								
<i>Tetrapterys</i> spp.	X			X												
<i>Tetrameles nudiflora</i>				X				X								
<i>Tetrameles labra</i>	X			X												
<i>Tieghemella heckelii</i>				X				X								
<i>Triplaria</i> spp.	X			X												
<i>Triplochiton</i>																
<i>aclerioides</i>																
<i>Tristania</i> spp.	X			X												
<i>Trophis</i> spp.																
<i>Turreanthus africanus</i>				X				X								
<i>Upaca</i> spp.	X			X												
<i>Upuna borneensis</i>	X															
<i>Vatairea</i> spp.	X			X				X								
<i>Vitex</i> spp.	X			X												
<i>Vitex doniana</i>				X												
<i>Vitex</i> spp. <i>Fiddlewood</i>				X												
<i>Vitex</i> spp. <i>Molave</i>	X			X				X								
<i>Vochysi</i> spp.				X				X								
<i>Vochysi</i> spp. <i>Vonacapoua americana</i>	X			X												
<i>Wallaceodendron</i> <i>celebicum</i>								X								
<i>Widderingtonia whytei</i>	X			X				X								
<i>Xylia xylocarpa</i>	X							X								
<i>Zanthoxylum flavum</i>																

Summary Reference Sheet for Decoding Table 11-1

COLOR		DENSITY		MECHANICAL PROPERTIES (12 PCT MOISTURE CONTENT)				
<u>Code</u>	<u>Color</u>	<u>Density</u> (Pcf)	<u>Code</u>	<u>Bending strength</u> (2-in. specimen) (Psi)	<u>Stiffness</u> (2-in. specimen) (1,000 psi)	<u>Crushing strength</u> (2-in. specimen) (Psi)	<u>Toughness</u> (FPL 2-cen- timeter) (In.-lb)	<u>Hardness,</u> <u>Janka side</u> (Lb)
1	Whitish, pale brown, pale yellow, straw	<20	—	—	—	—	—	—
2	Dark brown	20-30	—	—	—	—	—	—
3	Pink or red tints, including red brown	30-40	—	—	—	—	—	—
4	Other colors (black, purple, bright yellow, etc.)	40-50	1	<7,000	<1,000	<5,000	<180	<500
		50-60	2	7,000- 9,500	1,000- 1,400	5,000- 6,000	180-270	500-300
		>60	3	9,500-12,000	1,400-1,800	6,000- 7,000	270-360	800-1,100
			4	12,000-14,500	1,800-2,200	7,000- 8,000	360-450	1,100-1,400
			5	14,500-17,000	2,200-2,600	8,000- 9,000	450-540	1,400-1,700
			6	17,000-19,500	2,600-3,000	9,000-10,000	540-630	1,700-2,000
			7	>19,500	>3,000	>10,000	>630	>2,000

MOVEMENT		SHRINKAGE				HEARTWOOD DURABILITY			HEARTWOOD TREATABILITY	
<u>Code</u>	<u>Movement</u> (Pct)	<u>Code</u>	<u>Radial</u> <u>Green to</u> <u>overdry</u> (Pct)	<u>Green to</u> <u>airdry</u> (Pct)	<u>Tangential</u> <u>Green to</u> <u>overdry</u> (Pct)	<u>Green to</u> <u>airdry</u> (Pct)	<u>Classification</u>	<u>Code</u>	<u>Classification</u>	
1	Small, under 3.0	—	—	—	—	—	Very durable	1	Permeable	
2	Medium, 3.0-4.5	—	—	—	—	—	Durable	2	Moderately resistant	
3	Large--over 4.5	1	<3.0	<2.0	<5.0	<3.0	Moderately nondurable	3	Resistant	
		2	3.0-4.0	2.0-2.5	5.0-6.5	3.0-4.0	Nondurable	4	Extremely resistant	
		3	4.0-5.0	2.5-3.0	6.5-8.0	4.0-5.0	Perishable	5	—	
		4	5.0-6.0	3.0-3.5	8.0-9.5	5.0-6.0				
		5	>6.0	>3.5	>9.5	>6.0				

APPENDIXES

- A--Selected Forest Products Reference Material
- B--Trade Name Index
- C--Generic Synonyms
- D--Generic Groupings
- E--Derivation of Toughness Values

Appendix A--Selected Forest Product Reference Material

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Appendix B--Trade Name Index

ABACHI	AF	<i>Triplochiton scleroxylon</i>
ABALE	AF	<i>Combretodendron africanum</i>
ABEL	AF	<i>Canarium schweinfurthii</i>
ABOUDIKRO	AF	<i>Entandrophragma cylindricum</i>
ABURA	AF	<i>Mitragyna ciliata</i>
ACAJOU BLANC	AM	<i>Simarouba amara</i>
ACAFU	AM	<i>Vouacapoua americana</i>
ACEITUNO	AM	<i>Vitex spp.</i>
ADJOUABA	AF	<i>Dacryodes spp.</i>
ADOUNG	AF	<i>Monopetalanthus heitzii</i>
AFARA	AF	<i>Terminalia superba</i>
AFARA, BLACK	AF	<i>Terminalia ivorensis</i>
AFINA	AF	<i>Strombosia glaucescens</i>
AFRICAN BLACKWOOD	AF	<i>Dalbergia melanoxylon</i>
AFRICAN CANARIUM	AF	<i>Canarium schweinfurthii</i>
AFRICAN CELTIS	AF	<i>Celtis spp.</i>
AFRICAN CORKWOOD	AF	<i>Musanga cecropioides</i>
AFRICAN CRABWOOD	AF	<i>Carapa procera</i> and <i>C. grandiflora</i>
AFRICAN EBONY	AF	<i>Diospyros spp.</i>
AFRICAN HOMALIUM	AF	<i>Homalium spp.</i>
AFRICAN MAHOGANY	AF	<i>Khaya ivorensis</i> and <i>K. anthotheca</i>
AFRICAN MAHOGANY	AF	<i>Khaya grandifoliola</i> and <i>K. senegalensis</i>
AFRICAN PADAUK	AF	<i>Pterocarpus soyauxii</i>
AFRICAN PENCIL CEDAR	AF	<i>Juniperus procera</i>
AFRICAN-WALNUT	AF	<i>Lovoa trichilioides</i>
AFRORMOSIA	AF	<i>Pericopsis elata</i> , SYN. <i>Afrormosia elata</i>
AFZELIA	AF	<i>Afzelia spp.</i>
AGBA	AF	<i>Gossweilerodendron balsamiferum</i>
AGBOIN	AF	<i>Piptadeniastrum africanum</i>
AIELE	AF	<i>Canarium schweinfurthii</i>
AJI	AM	<i>Clarisia racemosa</i>
AKO	AF	<i>Antiaris spp.</i>
AKOM	AF	<i>Terminalia superba</i>
AKOMU	AF	<i>Pycnanthus angolensis</i>
ALAN	AS	<i>Shorea spp.</i> (Dark red meranti--red lauan group)
ALBARCO	AM	<i>Cariniana spp.</i> and <i>C. pyriformis</i>
ALBIZZIA	AF	<i>Albizia spp.</i>
ALERCE	AM	<i>Fitzroya cupressoides</i>
ALGARROBO	AM	<i>Hymenaea courbaril</i>
ALIGNA	AF	<i>Afzelia spp.</i>
ALMACIGO	AM	<i>Bursera simaruba</i>
ALMON	AS	<i>Shorea spp.</i> (Light red meranti--light red lauan group)
ALMOND WOOD, INDIAN	AS	<i>Terminalia catappa</i>
ALONE	AF	<i>Bombax spp.</i>
ALSTONIA	AF	<i>Alstonia congensis</i> and <i>A. boonei</i>
AMARANTH	AM	<i>Peltogyne spp.</i>

AMAZAKOUE	AF	<i>Guibourtia ehie</i>
AMAZOUE	AF	<i>Guibourtia ehie</i>
AMBOYNA BURL	AS	<i>Pterocarpus indicus</i>
AMENDOIM	AM	<i>Pterogyne nitens</i>
AMERICAN MUSKWOOD	AM	<i>Guarea spp.</i>
AMOORA	AS	<i>Amoora spp.</i>
ANAN	AS	<i>Fagraea spp.</i>
ANAURA	AM	<i>Licania spp.</i>
ANDAMAN PADAUK	AS	<i>Pterocarpus dalbergioides</i>
ANDIROBA	AM	<i>Carapa guianensis</i>
ANDOUNG	AF	<i>Monopetalanthus heitzii</i>
ANEGRE	AF	<i>Aningeria spp.</i>
ANGELICA TREE	AM	<i>Dendropanax arboreus</i>
ANGELIN	AM	<i>Andira inermis</i>
ANGELIQUE	AM	<i>Dicorynia guianensis</i>
ANGUEUK	AF	<i>Ongokea gore</i>
ANINGERIA	AF	<i>Aningeria spp.</i>
ANTIARIS	AF	<i>Antiaris spp.</i>
APA	AF	<i>Afzelia spp.</i>
APITONG	AS	<i>Dipterocarpus spp.</i>
APRONO	AF	<i>Mansonia altissima</i>
ARARACANEA	AM	<i>Aspidosperma spp. (Araracanga group)</i>
ARARIBA	AM	<i>Centrolobium spp.</i>
ARARIBA	AM	<i>Sickingia spp.</i>
ARERE	AF	<i>Triplochiton scleroxylon</i>
AROMATA	AM	<i>Clathrotropis spp.</i>
AUSTRALIAN-MAPLE	AS	<i>Flindersia spp.</i>
AUSTRALIAN RED-CEDAR	AS	<i>Cedrela spp.</i>
AVODIRE	AF	<i>Turreanthus africanus</i>
AYAN	AF	<i>Distemonanthus benthamianus</i>
AYOUS	AF	<i>Triplochiton scleroxylon</i>
AZOBÉ	AF	<i>Lophira alata</i>
BABOEN	AM	<i>Virola spp.</i>
BADI	AF	<i>Nauclea diderrichii</i>
BAGASSE	AM	<i>Bagassa guianensis</i>
BAGTIKAN	AS	<i>Parashorea spp.</i>
BAHIA	AF	<i>Mitragyna ciliata</i>
BAKU	AF	<i>Tieghemella heckelii and T. africana</i>
BALATA	AM	<i>Manilkara bidentata</i>
BALAU	AS	<i>Shorea spp. (Balau group)</i>
BALSA	AM	<i>Ochroma pyramidale, SYN. O. lagopus</i>
BALSAMO	AM	<i>Myroxylon balsamum</i>
BANAK	AM	<i>Virola spp.</i>
BANNIA	AM	<i>Swartzia spp.</i>
BANUYO	AS	<i>Wallaceodendron celebicum</i>
BARACARA	AM	<i>Ormosia spp.</i>
BAROMALLI	AM	<i>Catostemma spp.</i>
BASRALOCUS	AM	<i>Dicorynia guianensis</i>
BATAI	AS	<i>Albizia falcataria, SYN. A. falcata</i>
BEECH, MYRTLE-	AS	<i>Nothofagus spp.</i>

BEEFWOOD	AM	<i>Manilkara bidentata</i>
BELIAN	AS	<i>Eusideroxylon zwageri</i>
BENGE	AF	<i>Guibourtia arnoldiana</i>
BENGUET PINE	AS	<i>Pinus insularis</i> , SYN. <i>P. kesiya</i> and <i>P. khasya</i>
BENIN MAHOGANY	AF	<i>Khaya grandifoliola</i> and <i>K. senegalensis</i>
BENUANG	AS	<i>Octomeles sumatrana</i>
BERANGAN	AS	<i>Castanopsis</i> spp.
BERLINIA	AF	<i>Berlinia</i> spp.
BETE	AF	<i>Mansonia altissima</i>
BETHABARA	AM	<i>Tabebuia</i> spp. (Lapacho group)
BILINGA	AF	<i>Nauclea diderrichii</i>
BINTANGOR	AS	<i>Calophyllum</i> spp.
BINUANG	AS	<i>Octomeles sumatrana</i>
BISHOPWOOD	AS	<i>Bischofia javanica</i>
BITTER ANGELIM	AM	<i>Vatairea</i> spp.
BLACK AFARA	AF	<i>Terminalia ivorensis</i>
BLACK CABBAGE-BARK	AM	<i>Lonchocarpus</i> spp.
BLACK WATTLE	AS	<i>Acacia mollissima</i> , SYN. <i>A. mearnsii</i>
BLACKWOOD, AFRICAN	AF	<i>Dalbergia melanoxylon</i>
BLACKWOOD, AUSTRALIAN	AS	<i>Acacia melanoxylon</i>
BLUE MAHOE	AM	<i>Hibiscus elatus</i> and <i>H. tiliaceus</i>
BLUEGUM	AS	<i>Eucalyptus globulus</i>
BOCOTE	AM	<i>Cordia</i> spp. (Hard-wooded, dark-colored <i>Gerascanthus</i> group)
BOMBAY, WHITE	AS	<i>Terminalia procera</i>
BOIBAX	AF	<i>Bombax</i> spp.
BONGELE	AF	<i>Sterculia oblonga</i>
BORNEO CAMPHORWOOD	AS	<i>Dryobalanops</i> spp.
BORNEO IRONWOOD	AS	<i>Eusideroxylon zwageri</i>
BOSSE	AF	<i>Guarea cedrata</i> and <i>G. thompsonii</i>
BOXWOOD, MARACAIBO	AM	<i>Gossypiospermum praecox</i>
BOXWOOD, SAN DOMINGO	AM	<i>Phyllostylon brasiliensis</i>
BOXWOOD, WEST INDIAN	AM	<i>Gossypiospermum praecox</i>
BRAZIL-NUT TREE	AM	<i>Bertholletia excelsa</i>
BRAZILIAN-WALNUT	AM	<i>Phoebe porosa</i>
BROAD-LEAVED TEA-TREE	AS	<i>Melaleuca quinquenervia</i> , SYN. <i>M. leucadendron</i>
BROWN SILVERBALLI	AM	<i>Licaria</i> spp.
BRUSH BOX	AS	<i>Tristania</i> spp.
BUBINGA	AF	<i>Guibourtia</i> spp.
BULLETWOOD	AM	<i>Manilkara bidentata</i>
BURADA	AM	<i>Parinari</i> spp.
BURKEA	AF	<i>Burkea africana</i>
BURMA LANCEWOOD	AS	<i>Homalium</i> spp.
BURMA PADAUK	AS	<i>Pterocarpus macrocarpus</i>
CAGUI	AM	<i>Caryocar</i> spp.
CAIMITO	AM	<i>Cynodendron</i> spp. and <i>Chrysophyllum</i> spp.
CAJEPUT	AS	<i>Melaleuca quinquenervia</i> , SYN. <i>M. leucadendron</i>

CAMPHOR WOOD	AS	<i>Cinnamomum</i> spp.
CAMPHORWOOD, BORNEO	AS	<i>Dryobalanops</i> spp.
CAMPHORWOOD, EAST AFRICAN	AF	<i>Ocotea usambarensis</i>
CANALETE	AM	<i>Cordia</i> spp. (Hard-wooded, dark-colored Gerascanthus group)
CANANGA	AS	<i>Canangium odoratum</i>
CANARIUM, AFRICAN	AF	<i>Canarium schweinfurthii</i>
CANARY WOOD	AM	<i>Centrolobium</i> spp.
CANDLE TREE	AM	<i>Dacryodes excelsa</i>
CANELO	AM	<i>Nectandra</i> spp.
CANELA-ROSA	AM	<i>Persea</i> spp.
CANGERANA	AM	<i>Cabralea cangerana</i>
CAOBA	AM	<i>Swietenia macrophylla</i>
CAPOMO	AM	<i>Brosimum</i> spp. (<i>Alicastrum</i> group)
CAPOTE	AM	<i>Sterculia pruriens</i>
CARAPA	AM	<i>Carapa guianensis</i>
CARBONERO	AM	<i>Piptadenia pittieri</i> and <i>Piptadenia</i> spp.
CARNE D'ANTA	AM	<i>Maytenus</i> spp.
CASTANHEIRO	AM	<i>Bertholletia excelsa</i>
CASUARINA	AS	<i>Casuarina</i> spp.
CATIVO	AM	<i>Prioria copaifera</i>
CAVIUNA	AM	<i>Machaerium</i> spp.
CEDAR, AFRICAN PENCIL	AF	<i>Juniperus procera</i>
CEDAR, MLANJE	AF	<i>Widdringtonia whytei</i>
CEDAR, SPANISH-	AM	<i>Cedrela</i> spp.
CEDRO	AM	<i>Cedrela</i> spp.
CEDRO MACHO	AM	<i>Carapa guianensis</i>
CEDRO-RANA	AM	<i>Cedrelinga catenaeformis</i>
CEIBA	AF	<i>Ceiba pentandra</i>
CEIBA	AM	<i>Ceiba pentandra</i>
CELTIS, AFRICAN	AF	<i>Celtis</i> spp.
CHAMPACA	AS	<i>Michelia</i> spp.
CHANFUTA	AF	<i>Afzelia</i> spp.
CHEESEWOOD, WHITE	AS	<i>Alstonia</i> spp.
CHENCHEN	AF	<i>Antiaris</i> spp.
CHENGAL	AS	<i>Balanocarpus</i> spp.
CHEWSTICK	AM	<i>Symphonia globulifera</i>
CHICHA	AM	<i>Sterculia apetala</i>
CHICHA BRAVA	AM	<i>Sterculia pruriens</i>
CHICKRASSY	AS	<i>Chukrasia tabularis</i>
CHINABERRY TREE	AS	<i>Melia azedarach</i>
CHUGLAM, WHITE	AS	<i>Terminalia bialata</i>
CHUMPRAK	AS	<i>Heritiera</i> spp., SYN. <i>Tarrietia</i> spp.
CHUPON	AM	<i>Pradosia</i> spp.
CINNAMON WOOD	AS	<i>Cinnamomum</i> spp.
COCOBOLO	AM	<i>Dalbergia retusa</i>
COFFEEWOOD	AM	<i>Caesalpinia</i> spp., SYN. <i>Libidiba</i> spp.
COIGUE	AM	<i>Nothofagus dombeyi</i>
CONGOWOOD	AF	<i>Lovoa trichiliooides</i>
COPAIA	AM	<i>Jacarana copaia</i>

COPAIBA	AM	<i>Copaifera</i> spp.
COPAL	AM	<i>Protium</i> spp.
CORDIA	AS	<i>Cordia</i> spp.
CORDIA, WEST AFRICAN	AF	<i>Cordia millenii</i> and <i>C. platythyrsa</i>
CORDYLA	AF	<i>Cordyla africana</i>
COURBARIL	AM	<i>Hymenaea courbaril</i>
COW TREE	AM	<i>Couma macrocarpa</i>
COW-TREE	AM	<i>Brosimum</i> spp. (<i>Utile</i> group)
CRABWOOD	AM	<i>Carapa guianensis</i>
CRABWOOD, AFRICAN	AF	<i>Carapa procera</i> and <i>C. grandiflora</i>
CRAMANTEE	AM	<i>Guarea</i> spp.
CUANGARE	AM	<i>Dialyanthera</i> spp.
CURUPAY	AM	<i>Anadenanthera macrocarpa</i> , SYN. <i>Piptadenia macrocarpa</i>
CURUPI	AM	<i>Sapium</i> spp.
CYPRESS-PINE, WHITE	AS	<i>Callitris glauca</i> , SYN. <i>C. columellaris</i>
DABEMA	AF	<i>Piptadeniastrum africanum</i>
DAHOMA	AF	<i>Piptadeniastrum africanum</i>
DAKUA	AS	<i>Agathis</i> spp.
DANIELLIA	AF	<i>Daniellia ogea</i> and <i>D. thurifera</i>
DANTA	AF	<i>Nesogordonia papaverifera</i>
DAO	AS	<i>Dracontomelum</i> spp.
DARAH DARAH	AS	<i>Myristica</i> spp. and <i>Knema</i> spp.
DARK RED MERANTI	AS	<i>Shorea</i> spp. (Dark red meranti--red lauan group)
DARK RED SERAYA	AS	<i>Shorea</i> spp. (Dark red meranti--red lauan group)
DAU	AS	<i>Dipterocarpus</i> spp.
DEGAME	AM	<i>Calycophyllum candidissimum</i>
DEGLUPTA	AS	<i>Eucalyptus deglupta</i>
DEMERARA GREENHEART	AM	<i>Ocotea rodiae</i>
DETERMA	AM	<i>Ocotea rubra</i>
DIFOU	AF	<i>Morus mesozygia</i>
DILLENTIA	AS	<i>Dillenia</i> spp.
DIMPAMPI	AF	<i>Baillonella toxisperma</i>
DINA	AF	<i>Swartzia fistuloides</i>
DJEDOE	AM	<i>Sclerolobium</i> spp.
DOUKA	AF	<i>Tieghemella heckelii</i> and <i>T. africana</i>
DOUM	AF	<i>Ceiba pentandra</i>
DOUSSIE	AF	<i>Afzelia</i> spp.
DURIAN	AS	<i>Durio</i> spp. and <i>Neesia</i> spp.
DURU	AM	<i>Apeiba</i> spp.
EAST AFRICAN CAMPHORWOOD	AF	<i>Ocotea usambarensis</i>
EAST AFRICAN OLIVE	AF	<i>Olea hochstetteri</i>
EAST AFRICAN SATINWOOD	AF	<i>Fagara macrophylla</i>
EAST INDIAN EBONY	AS	<i>Diospyros</i> spp.
EAST INDIAN SATINWOOD	AS	<i>Chloroxylon swietenia</i>
EBONY, AFRICAN	AF	<i>Diospyros</i> spp.
EBONY, EAST INDIAN	AS	<i>Diospyros</i> spp.

EKEBERGIA	AF	Ekebergia rueppelliana
EKHIMI	AF	Piptadeniastrum africanum
EKKI	AF	Lophira alata
EKOP	AF	Tetraberlinia tubmaniana
EKPOGOI	AF	Berlinia spp.
ELEMI	AF	Canarium schweinfurthii
EMERI	AF	Terminalia ivorensis
ENCINO	AM	Quercus spp.
ENG	AS	Dipterocarpus spp.
ENVIREIRA	AM	Sterculia pruriens
EPRO	AF	Nesogordonia papaverifera
ERIMA	AS	Octomeles sumatrana
ERIMADO	AF	Ricinodendron heudelotii
ESA	AF	Celtis spp.
ESPAVE	AM	Anacardium excelsum
ESSIA	AF	Combretodendron macrocarpum, SYN. C. africanum
ESTRIBEIRO	AM	Luehea spp.
EVEUSS	AF	Klainedoxa gabonensis
EYONG	AF	Sterculia oblonga
EYOUM	AF	Dialium dinklagei
FARO	AF	Daniellia ogea and D. thurifera
FAVEIRA	AM	Vatairea spp.
FIDDLEWOOD	AM	Vitex spp.
FIGUEROA	AM	Carapa guianensis
FOENGOE	AM	Parinari spp.
FRAKE	AF	Terminalia superba
FRAMIRE	AF	Terminalia ivorensis
FREIJO	AM	Cordia spp. (Soft-wooded light-colored Alliodora group)
FRIJOLILLO	AM	Pseudosamanea guachapele
FROMAGER	AF	Ceiba pentandra
FUMA	AF	Ceiba pentandra
FUSTIC	AM	Chlorophora tinctoria
GABOON	AF	Aucoumea klaineana
GAGIL	AS	Hopea spp.
GANGAW	AS	Mesua ferrea
GEDU NOHOR	AF	Entandrophragma angolense
GENIPA	AM	Genipa americana
GERONGGANG	AS	Cratoxylon arborescens
GMELINA	AS	Gmelina arborea
GOMMIER	AM	Dacryodes excelsa
GONÇALO ALVES	AM	Astronium graveolens
GRANAADILLO	AM	Dalbergia retusa
GREENHEART, DEMERARA	AM	Ocotea rodiaeae
GREVILLEA	AS	Grevillea robusta
GRIGNON FOU	AM	Qualea spp.
GRONFOELOE	AM	Qualea spp.

GRUMIXAVA	AM	<i>Micropholis</i> spp.
GUACHAPELE	AM	<i>Pseudosamanea guachapele</i>
GUACIMO	AM	<i>Luehea</i> spp.
GUANACASTE	AM	<i>Enterolobium cyclocarpum</i>
GUAREA	AF	<i>Guarea cedrata</i> and <i>G. thompsonii</i>
GUATAMBU	AM	<i>Balfourodendron riedelianum</i>
GUAYACAN	AM	<i>Guaiacum</i> spp.
GUBAS	AS	<i>Endospermum</i> spp.
GUMBO-LIMBO	AM	<i>Bursera simaruba</i>
GUMHAR	AS	<i>Gmelina arborea</i>
GURJUN	AS	<i>Dipterocarpus</i> spp.
HAIARI	AM	<i>Alexa imperatricis</i>
HAIARIBALLI	AM	<i>Alexa imperatricis</i>
HALDU	AS	<i>Adina cordifolia</i>
HOBO	AM	<i>Spondias mombin</i>
HOG PLUM	AM	<i>Spondias mombin</i>
HOMALIUM, AFRICAN	AF	<i>Homalium</i> spp.
HOOP-PINE	AS	<i>Araucaria</i> spp.
HURA	AM	<i>Hura crepitans</i>
HUYNH	AS	<i>Heritiera</i> spp.
IDIGBO	AF	<i>Terminalia ivorensis</i>
ILIMO	AS	<i>Octomeles sumatrana</i>
ILOMBA	AF	<i>Pycnanthus angolensis</i>
IMBUIA	AM	<i>Phoebe porosa</i>
INCENSO	AF	<i>Daniellia ogea</i> and <i>D. thurifera</i>
INDIAN ALMOND WOOD	AS	<i>Terminalia catappa</i>
INDIAN LAUREL	AS	<i>Terminalia tomentosa</i> complex
INDIAN ROSEWOOD	AS	<i>Dalbergia latifolia</i>
IPE	AM	<i>Tabebuia</i> spp. (Lapacho group)
IPIL	AS	<i>Intsia biuga</i> and <i>I. palembanica</i>
IROKO	AF	<i>Chlorophora excelsa</i> and <i>C. regia</i>
IRONWOOD, BORNEO	AS	<i>Eusideroxylon zwageri</i>
IZOMBE	AF	<i>Testulea gabonensis</i>
JABILLO	AM	<i>Hura crepitans</i>
JACARANDA	AM	<i>Dalbergia nigra</i>
JACAREUBA	AM	<i>Calophyllum brasiliense</i>
JAGUA	AM	<i>Genipa americana</i>
JARANA	AM	<i>Holopyxidium jarana</i>
JARRAH	AS	<i>Eucalyptus marginata</i>
JELUTONG	AS	<i>Dyera costulata</i>
JEQUITIBA	AM	<i>Cariniana pyriformis</i> and <i>Cariniana</i> spp.
JOBO	AM	<i>Spondias mombin</i>
JONGKONG	AS	<i>Dactylocladus stenostachys</i>
JUCARO	AM	<i>Bucida buceras</i>
JUTAHY	AM	<i>Dialium guianense</i>

KABUKALLI	AM	<i>Gouphia glabra</i>
KADAM	AS	<i>Anchocephalus chinensis</i> , SYN. <i>A. cadamba</i>
KAKERALLI	AM	<i>Eschweilera</i> spp.
KAMASSI	AF	<i>Gonioma kamassi</i>
KAMBALA	AF	<i>Chlorophora excelsa</i> and <i>C. regia</i>
KANDIS	AS	<i>Garcinia</i> spp.
KANEELHART	AM	<i>Licaria</i> spp.
KAPOER	AS	<i>Dryobalanops</i> spp.
KAPOK-TREE	AM	<i>Ceiba pentandra</i>
KAPUR	AS	<i>Dryobalanops</i> spp.
KARRI	AS	<i>Eucalyptus diversicolor</i>
KASAI	AS	<i>Pometia</i> spp.
KAURI	AS	<i>Agathis</i> spp.
KAUTA	AM	<i>Licania</i> spp.
KAUVULA	AS	<i>Endospermum</i> spp.
KAYU MALAM	AS	<i>Diospyros</i> spp.
KEDONDONG	AS	<i>Canarium</i> spp.
KEKATONG	AS	<i>Cynometra</i> spp.
KELADAN	AS	<i>Dryobalanops</i> spp.
KELAT	AS	<i>Eugenia</i> spp.
KELEDANG	AS	<i>Artocarpus</i> spp.
KELOBRA	AM	<i>Enterolobium cyclocarpum</i>
KEMBANG	AS	<i>Heritiera</i> spp.
KEMPAS	AS	<i>Koompassia malaccensis</i>
KERANJI	AS	<i>Dialium</i> spp.
KERUING	AS	<i>Dipterocarpus</i> spp.
KEVAZINGO	AF	<i>Guibourtia</i> spp.
KIRIKAWA	AM	<i>Iryanthera</i> spp.
KI RUNDO	AF	<i>Antiaris</i> spp.
KLINKI-PINE	AS	<i>Araucaria</i> spp.
KOKKO	AS	<i>Albizia lebbek</i>
KOKRIKI	AM	<i>Ormosia</i> spp.
KOKRODUA	AF	<i>Pericopsis elata</i>
KOPIE	AM	<i>Gouphia glabra</i>
"KORINA"	AF	<i>Terminalia superba</i>
KOSIPO	AF	<i>Entandrophragma candollei</i>
KOTIBE	AF	<i>Nesogordonia papaverifera</i>
KOTO	AF	<i>Pterygota</i> spp.
KRABAK	AS	<i>Anisoptera</i> spp.
KRAPA	AM	<i>Carapa guianensis</i>
KULIM	AS	<i>Scorodocarpus borneensis</i>
KUROKAI	AM	<i>Protium</i> spp.
KUSIA	AF	<i>Nauclea diderrichii</i>
KUSIABA	AF	<i>Nauclea diderrichii</i>
KWAO	AS	<i>Adina cordifolia</i>
KWARI	AM	<i>Vochysia</i> spp.
KYENKYEN	AF	<i>Antiaris</i> spp.
LACEWOOD	AS	<i>Grevillea robusta</i>
LAMPATI	AS	<i>Duabanga</i> spp.
LANCEWOOD, BURMA	AS	<i>Homalium</i> spp.

LANCEWOOD, WEST INDIAN	AM	Oxandra lanceolata
LANDA	AF	Erythroxylum manii
LANDOSAN	AF	Aningeria spp.
LAPACHO	AM	Tabebuia spp. (Lapacho group)
LAUAN, LIGHT RED	AS	Shorea spp. (Light red meranti--light red lauan group)
LAUAN, RED	AS	Shorea spp. (Dark red meranti--red lauan group)
LAUAN, WHITE	AS	Pentacme contorta
LAUREL	AM	Nectandra spp.
LAUREL BLANCO	AM	Cordia spp. (Soft-wooded light-colored Alliodora group)
LAUREL, INDIAN	AS	Terminalia tomentosa complex
LECHE PERRA	AM	Helicostylis tomentosa
LECHERO	AM	Sapium spp.
LEMONWOOD	AM	Calycophyllum candidissimum
LETTERWOOD	AM	Piratinera guianensis, SYN. Brosimum guianensis
LIGHT RED LAUAN	AS	Shorea spp. (Light red meranti--light red lauan group)
LIGHT RED MERANTI	AS	Shorea spp. (Light red meranti--light red lauan group)
LIGNUMVITAE	AM	Guaiacum spp.
LIMBA	AF	Terminalia superba
LINGUE	AM	Persea spp.
LOKTOB	AS	Duabanga spp.
LONG JOHN	AM	Triplaris spp.
LONGUI	AF	Gambeya africana, SYN. Chrysophyllum africanum
LOURO	AM	Aniba spp.
LOURO PARDO	AM	Cordia spp. (Hard-wooded dark-colored Gerascanthus group)
LOURO VERMELHO	AM	Ocotea rubra
LOVOA	AF	Lovoa trichilioides
LUMBAYAU	AS	Heritiera spp.
MACAWOOD	AM	Platymiscium spp.
MACHANG	AS	Mangifera spp.
MACHILUS	AS	Machilus spp.
MAFU	AF	Fagaropsis angolensis
MAGAS	AS	Duabanga spp.
MAGNOLIA	AM	Magnolia spp.
MAHO	AM	Sterculia pruriens
MAHOE, BLUE	AM	Hibiscus elatus and H. ciliaceus
MAHOGANY, AFRICAN	AF	Khaya grandifoliola and K. senegalensis
MAHOGANY, AFRICAN	AF	Khaya ivorensis and K. anthotheca
MAHOGANY, BENIN	AF	Khaya grandifoliola and K. senegalensis
MAHOGANY, HONDURAS	AM	Swietenia macrophylla
MAHOGANY, SENEGAL	AF	Khaya grandifoliola and K. senegalensis
MAHOT	AM	Couratari spp.
MAI PRADOO	AS	Pterocarpus macrocarpus

MAKORE	AF	Tieghemella heckelii and T. africana
MALAS	AS	Homalium spp.
MANBARKLAK	AM	Eschweilera spp.
MANDIOQUERA	AM	Qualea spp.
MANGLE COLORADO	AM	Rhizophora mangle
MANGO	AS	Mangifera spp.
MANIO	AM	Podocarpus spp.
MANNI	AM	Sympomia globulifera
MANSONIA	AF	Mansonia altissima
MAPLE, AUSTRALIAN-	AS	Flindersia spp.
MARACAIBO LIGNUM-VITAE	AM	Bulnesia arborea
MARAKAIPÓ	AM	Iryanthera spp.
MARANGGO	AS	Azadirachta spp.
MARISHBALLI	AM	Licania spp.
MARUPA	AM	Simarouba spp.
MASA	AM	Tetragastris spp.
MASTATE	AM	Poulsenia armata
MAYAPIS	AS	Shorea spp. (Light-red meranti-- light red lauan group)
MAYFLOWER	AM	Tabebuia spp. (Roble group)
MBAMAKOFI	AF	Afzelia spp.
MBANKO	AF	Odyendea spp.
MBARIKA	AF	Isoberlinia scheffleri
MECRUSSE	AF	Androstachys johnsonii
MEDANG	AS	Litsea spp.
MELAWIS	AS	Gonystylus spp.
MENDOU	AF	Brachystegia spp.
MENGKULANG	AS	Heritiera spp., SYN. Tarrietia spp.
MERANTI, DARK RED	AS	Shorea spp. (Dark red meranti-- red lauan group)
MERANTI, LIGHT RED	AS	Shorea spp. (Light red meranti-- light red lauan group)
MERANTI, YELLOW	AS	Shorea spp. (Yellow meranti group)
MERANTI, WHITE	AS	Shorea spp. (White meranti group)
MERAWAN	AS	Hopea spp.
MERBAU	AS	Intsia biuga and I. palembanica
MERKUS PINE	AS	Pinus merkusii
MERPAUH	AS	Swintonia spp.
MERSAWA	AS	Anisoptera spp.
MERU-OAK	AF	Vitex doniana
MEXICAN CYPRESS	AM	Cupressus lusitanica
MIERENHOUT	AM	Triplaris spp.
MISSANDA	AF	Erythrophleum ivorense and E. guineense
MKORA	AF	Afzelia spp.
MLANJE-CEDAR	AF	Widdringtonia whytei
MOABI	AF	Baillonella toxisperma
MOLAVE	AS	Vitex spp.
MOLUCCA ALBIZZIA	AS	Albizia falcataria, SYN. A. falcata
MONKEY POT	AM	Lecythis spp.
MORA	AM	Mora excelsa and M. gonggrijpii

MORA AMARILLA	AM	<i>Chlorophora tinctoria</i>
MORABUKEA	AM	<i>Mora excelsa</i> and <i>M. gonggrijpii</i>
MORADO	AM	<i>Peltogyne</i> spp.
MORILLO	AM	<i>Trophis</i> spp.
MOROTOTO	AM	<i>Didymopanax morototoni</i>
MOVINGUI	AF	<i>Distemonanthus benthamianus</i>
"MOZAMBIQUE"	AF	<i>Guibourtia ehie</i>
MTAMBARA	AF	<i>Cephalosphaera usambarensis</i>
MTUNDU	AF	<i>Brachystegia spiciformis</i>
MUBARA	AF	<i>Parinari excelsa</i>
MUERI	AF	<i>Pygeum africanum</i> , SYN. <i>Prunus africanum</i>
MUHIMBI	AF	<i>Cynometra alexandri</i>
MUHUHU	AF	<i>Brachylaena hutchinsii</i>
MUIRATINGA	AM	<i>Brosimum</i> spp. (<i>Alicastrum</i> group)
MUIRUNGI	AF	<i>Casearia battiscombei</i>
MUKANGU	AF	<i>Aningeria</i> spp.
MUKULUNGU	AF	<i>Autranella congolensis</i>
MUNINGA	AF	<i>Pterocarpus angolensis</i>
MUSINE	AF	<i>Croton megalocarpus</i>
MUSIZI	AF	<i>Maesopsis eminii</i>
MUSSACOSSA	AF	<i>Afzelia</i> spp.
MUTENYE	AF	<i>Guibourtia arnoldiana</i>
MUWA	AF	<i>Julbernardia globiflora</i>
MWAFU	AF	<i>Canarium schweinfurthii</i>
MYRTLE-BEECH	AS	<i>Nothofagus</i> spp.
MYRTLE, TASMANIAN-	AS	<i>Nothofagus</i> spp.
NARGUSTA	AM	<i>Terminalia amazonia</i>
NARRA	AS	<i>Pterocarpus indicus</i>
NEEDLEWOOD	AS	<i>Schima</i> spp.
NEEM	AS	<i>Azadirachta</i> spp.
NEW GUINEA-WALNUT	AS	<i>Dracontomelum</i> spp.
NEW GUINEAWOOD	AS	<i>Dracontomelum</i> spp.
NIANGON	AF	<i>Tarrietia utilis</i> and <i>T. densiflora</i>
NIOVE	AF	<i>Staudtia stipitata</i> , SYN. <i>S. gabonensis</i>
NJABI	AF	<i>Baillonella toxisperma</i>
NKOBAKOBA	AF	<i>Baikiae insignis</i> subsp. <i>minor</i>
NOGAL	AM	<i>Juglans</i> spp.
NONGO	AF	<i>Albizia</i> spp.
N'TOLA	AF	<i>Gossweilerodendron balsamiferum</i>
NYANKOM	AF	<i>Tarrietia utilis</i> and <i>T. densiflora</i>
NYATOH	AS	<i>Palaquium</i> spp. and <i>Payena</i> spp.
NZINGU	AF	<i>Micragyna ciliata</i>
OAK	AM	<i>Quercus</i> spp.
OBA	AF	<i>Irvingia gabonensis</i>
OBECHE	AF	<i>Triplochiton scleroxylon</i>
OBOBO	AF	<i>Guarea cedrata</i> and <i>G. thompsonii</i>
OBOTO	AF	<i>Mammea africana</i>
OCOTE PINE	AM	<i>Pinus oocarpa</i>

ODOKO	AF	<i>Scottellia coriaceae</i>
OFRAM	AF	<i>Terminalia superba</i>
OFUN	AF	<i>Mansonia altissima</i>
OGEA	AF	<i>Daniellia ogea</i> and <i>D. thurifera</i>
OGIOVU	AF	<i>Antiaris</i> spp.
OHIA	AF	<i>Celtis</i> spp.
OHIA	AS	<i>Metrosideros collina</i> , subsp. <i>polymorpha</i>
OITICICA AMARELA	AM	<i>Clarisia racemosa</i>
OJOCHE	AM	<i>Brosimum</i> spp. (<i>Alicastrum</i> group)
OKAN	AF	<i>Cylicodiscus gabunensis</i>
OKOKO	AF	<i>Sterculia oblonga</i>
OKOUME	AF	<i>Aucoumea klaineana</i>
OKWEN	AF	<i>Brachystegia</i> spp.
OLIVE, EAST AFRICAN	AF	<i>Olea hochstetteri</i>
OLIVIER, WHITE	AM	<i>Terminalia amazonia</i>
OMU	AF	<i>Entandrophragma candollei</i>
ONZANG	AF	<i>Odyendea</i> spp.
OPEPE	AF	<i>Nauclea diderrichii</i>
OREY	AM	<i>Campnosperma panamensis</i>
ORIENTALWOOD	AS	<i>Endiandra palmerstonii</i>
ORO	AF	<i>Antiaris</i> spp.
OSAN	AF	<i>Aningeria</i> spp.
OTIE	AF	<i>Pycnanthus angolensis</i>
OTUTU	AF	<i>Nesogordonia papaverifera</i>
OVANGKOL	AF	<i>Guibourtia ehie</i>
OVOGA	AF	<i>Poga oleosa</i>
OWEWE	AF	<i>Combretodendron macrocarpum</i>
OXHORN BUCIDA	AM	<i>Bucida buceras</i>
OZIGO	AF	<i>Dacryodes</i> spp.
OZIYA	AF	<i>Daniellia ogea</i> and <i>D. thurifera</i>
PACURI	AM	<i>Rheedia</i> spp.
PADAUK, AFRICAN	AF	<i>Pterocarpus soyauxii</i>
PADAUK, ANDAMAN	AS	<i>Pterocarpus dalbergioides</i>
PADAUK, BURMA	AS	<i>Pterocarpus macrocarpus</i>
PALDAO	AS	<i>Dracontomelum</i> spp.
PALOSAPIS	AS	<i>Anisoptera</i> spp.
PANGA PANGA	AF	<i>Millettia</i> spp.
PAPER-BARK	AS	<i>Melaleuca quinquenervia</i>
PARA RUBBERTREE	AM	<i>Hevea brasiliensis</i>
PARA-ANGELIM	AM	<i>Hymenolobium excelsum</i>
PARANA-PINE	AM	<i>Araucaria angustifolia</i>
PARTRIDGE WOOD	AM	<i>Andira inermis</i>
PARTRIDGEWOOD	AM	<i>Caesalpinia</i> spp., SYN. <i>Libidibia</i> spp.
PAU AMARELLO	AM	<i>Euxylophora paraensis</i>
PAU FERRO	AM	<i>Machaerium</i> spp.
PAU MARFIM	AM	<i>Balfourodendron riedelianum</i>
PENAK	AS	<i>Balanocarpus</i> spp.
PEREPAT	AS	<i>Sonneratia</i> spp.
PEROBA DE CAMPOS	AM	<i>Paratecoma peroba</i>
PEROBA ROSA	AM	<i>Aspidosperma</i> spp. (Peroba group)

PEROBA, WHITE	AM	<i>Paratecoma peroba</i>
PERSIAN LILAC	AS	<i>Melia azedarach</i>
PERUPOK	AS	<i>Lophopetalum spp.</i>
PETEREBI	AM	<i>Cordia spp.</i> (Soft-wooded, light-colored Alliodora group)
PHDIEK	AS	<i>Anisoptera spp.</i>
PILLARWOOD	AF	<i>Cassipourea malosana</i>
PILON	AM	<i>Hyeronima alchorneoides</i> and <i>H. laxiflora</i>
PINE, BENGUET	AS	<i>Pinus insularis</i> , SYN. <i>P. Kesiya</i> and <i>P. Khasya</i>
PINE, CARIBBEAN	AM	<i>Pinus caribaea</i>
PINE, MERKUS	AS	<i>Pinus merkusii</i>
PINE, OOCARPA	AM	<i>Pinus oocarpa</i>
PINE, PATULA	AM	<i>Pinus patula</i>
PIPLI	AS	<i>Bucklandia populnea</i>
PIQUIA	AM	<i>Caryocar spp.</i>
POCHOTE	AM	<i>Bombacopsis quinata</i>
PODO	AF	<i>Podocarpus spp.</i>
PODOCARP	AM	<i>Podocarpus spp.</i>
POON	AS	<i>Calophyllum spp.</i>
PORCUPINE WOOD	AM	<i>Centrolobium spp.</i>
POSSUMWOOD	AM	<i>Hura crepitans</i>
PRADOO	AS	<i>Pterocarpus macrocarpus</i>
PRIMAVERA	AM	<i>Cybistax donnell-smithii</i> , SYN. <i>Tabebuia donnell-smithii</i>
PTERYGOTA	AF	<i>Pterygota spp.</i>
PULAI	AS	<i>Alstonia spp.</i>
PUNAH	AS	<i>Tetramerista glabra</i>
PURPLEHEART	AM	<i>Peltogyne spp.</i>
PUTAT PAYA	AS	<i>Planchonia spp.</i>
PYCNANTHUS	AF	<i>Pycnanthus spp.</i>
PYINKADO	AS	<i>Xylia xylocarpa</i>
PYINMA	AS	<i>Lagerstroemia spp.</i>
QUARUBA	AM	<i>Vochysia spp.</i>
QUEBRACHO	AM	<i>Schinopsis spp.</i>
QUEENSLAND-MAPLE	AS	<i>Flindersia spp.</i>
QUEENSLAND-WALNUT	AS	<i>Endiandra palmerstonii</i>
RAINTREE	AM	<i>Pithecellobium saman</i> , SYN. <i>Samanea saman</i>
RAMIN	AS	<i>Gonystylus spp.</i>
RAMON	AM	<i>Trophis spp.</i>
RANGGU	AS	<i>Koordersiodendron pinnatum</i>
RAULI	AM	<i>Nothofagus procera</i>
RED LAUAN	AS	<i>Shorea spp.</i> (Dark red meranti-- red lauan group)
RED LOURO	AM	<i>Ocotea rubra</i>
RED MANGROVE	AM	<i>Rhizophora mangle</i>
RED SERAYA	AS	<i>Shorea spp.</i> (Light red meranti-- light red lauan group)

RED-CEDAR, AUSTRALIAN	AS	Cedrela spp.
REMELENTO	AM	Rheedia spp.
RENGAS	AS	Gluta spp. and Melanorrhoea spp.
RESAK	AS	Cotylelobium spp. and Vatica spp.
RESAK	AS	Upuna borneensis
RHODESIAN-TEAK	AF	Baikiaea plurijuga
RIEMHOUT	AM	Micropholis spp.
RIMU	AS	Dacrydium spp.
ROBLE	AM	Quercus spp.
ROBLE	AM	Tabebuia spp. (Roble group)
ROSE-MAPLE	AS	Cryptocarya spp.
ROSEWOOD, BRAZILIAN	AM	Dalbergia nigra
ROSEWOOD, HONDURAS	AM	Dalbergia stevensonii
ROSEWOOD, INDIAN	AS	Dalbergia latifolia
SABICU	AM	Lysiloma spp.
SAFOUKALA	AF	Dacryodes spp.
SAJO	AM	Campnosperma panamensis
SALI	AM	Tetragastris spp.
SAMAN	AM	Pithecellobium saman, SYN. Samanea saman
SAMBA	AF	Triplochiton scleroxylon
SANDALWOOD	AS	Santalum album
SANDE	AM	Brosimum spp. (Utile group)
SANGRE	AM	Pterocarpus spp.
SANTA MARIA	AM	Calophyllum brasiliense
SAPELE	AF	Entandrophragma cylindricum
SAPO	AF	Didelotia brevipaniculata
SAPUCAI	AM	Lecythis spp.
SATINWOOD, EAST AFRICAN	AF	Fagara macrophylla
SATINWOOD, EAST INDIAN	AS	Chloroxylon swietenia
SATINWOOD, WEST INDIAN	AM	Zanthoxylum flavum, SYN. Fagara flava
SENEGAL MAHOGANY	AF	Khaya grandifoliola and K. senegalensis
SENGKUANG	AS	Dracontomelum spp.
SEPETIR	AS	Pseudosindora palustris and Sindora spp.
SERAYA, DARK RED	AS	Shorea spp. (Dark red meranti--red lauan group)
SERAYA, RED	AS	Shorea spp. (Light red meranti--light red lauan group)
SERAYA, WHITE	AS	Parashorea spp.
SERAYA, YELLOW	AS	Shorea spp. (Yellow meranti group)
SERRETTE	AM	Byrsinima coriacea var. spicata and Byrsinima spp.
SILK-COTTON-TREE	AF	Ceiba pentandra
SILK-COTTON-TREE	AM	Ceiba pentandra
SILKY-OAK	AS	Grevillea robusta
SIMAROUBA	AM	Simarouba amara
SIMPOH	AS	Dillenia spp.
SIPO	AF	Entandrophragma utile
SNAKEWOOD	AM	Piratinera guianensis, SYN. Brosimum guianensis

SORRO	AF	<i>Scyphocephalium ochocoa</i>
SOUGUE	AF	<i>Tarinari excelsa</i>
SPANISH-CEDAR	AM	<i>Cedrela spp.</i>
STAR-APPLE	AM	<i>Cynodendron spp. and Chrysophyllum spp.</i>
STERCULIA	AM	<i>Sterculia pruriens</i>
STERCULIA, BROWN	AF	<i>Sterculia rhinopetala</i>
STERCULIA, YELLOW	AF	<i>Sterculia oblonga</i>
SUBAHA	AF	<i>Mitragyna ciliata</i>
SUCUPIRA	AM	<i>Boudichia spp.</i>
SUCUPIRA	AM	<i>Diptotropis purpurea</i>
SUGAR-PLUM	AF	<i>Uapaca spp.</i>
SURADAN	AM	<i>Hyeronima alchorneoides and H. laxiflora</i>
TANGARE	AM	<i>Carapa guianensis</i>
TANGILE	AS	<i>Shorea spp. (Dark red meranti--red lauan group)</i>
TASMANIAN-MYRTLE	AS	<i>Nothofagus spp.</i>
TATABU	AM	<i>Diplotropis purpurea</i>
TAUARY	AM	<i>Couratari spp.</i>
TAUN	AS	<i>Pometia spp.</i>
TAURONIRO	AM	<i>Humiria balsamifera</i>
TAWA	AS	<i>Beilschmiedia tawa</i>
TCHITOLA	AF	<i>Oxystigma oxyphyllum</i>
TEA-TREE, BROAD-LEAVED	AS	<i>Melaleuca quinquenervia, SYN. M. leucadendron</i>
TEAK	AS	<i>Tectona grandis</i>
TEMBUSU	AS	<i>Fagraea spp.</i>
THINGAN	AS	<i>Hopea spp.</i>
THITKA	AS	<i>Pentace spp.</i>
THITMIN	AS	<i>Podocarpus spp.</i>
THITNI	AS	<i>Amoora spp.</i>
THITPOK	AS	<i>Tetrameles nudiflora</i>
TIAMA	AF	<i>Entandrophragma angolense</i>
TIGERWOOD	AF	<i>Lovoa trichilioides</i>
TIMBAUBA	AM	<i>Enterolobium schomburgkii</i>
TOLA	AF	<i>Gossweilerodendron balsamiferum</i>
TOLA MAFUTA	AF	<i>Oxystigma oxyphyllum</i>
TONKA	AM	<i>Dipteryx odorata, SYN. Coumarouna odorata</i>
TOON	AS	<i>Cedrela spp.</i>
TORNILLO	AM	<i>Cedrelinga catenaeformis</i>
TOTARA	AS	<i>Podocarpus spp.</i>
TREBOL	AM	<i>Platymiscium spp.</i>
TRUMPET-WOOD	AM	<i>Cecropia peltata</i>
TURPENTINE	AS	<i>Syncarpia glomulifera, SYN. S. laurifolia</i>
TURPENTINE TREE	AM	<i>Bursera simaruba</i>
T'ZALAM	AM	<i>Lysiloma spp.</i>
ULMO	AM	<i>Eucryphia cordifolia</i>
UMBRELLA TREE	AF	<i>Musanga cecropioides</i>

UMIRI	AM	<i>Humiria balsamifera</i>
UPUN BATU	AS	<i>Upuna borneensis</i>
URAT MATA	AS	<i>Parashorea spp.</i>
UTILE	AF	<i>Entandrophragma utile</i>
VACO	AM	<i>Magnolia spp.</i>
VEN-VEN	AS	<i>Anisoptera spp.</i>
VERAWOOD	AM	<i>Bulnesia arborea</i>
VERMILLION WOOD	AS	<i>Pterocarpus dalbergioides</i>
VIOLETWOOD	AM	<i>Peltogyne spp.</i>
VIRARO	AM	<i>Pterogyne nitens</i>
"VIROLA"	AM	<i>Dialyanthera spp.</i>
VITEX	AF	<i>Vitex doniana</i>
WACAPOU	AM	<i>Vouacapoua americana</i>
WALELE	AF	<i>Pycnanthus angolensis</i>
WALLABA	AM	<i>Eperua spp.</i>
WALNUT, NEW GUINEA-	AS	<i>Dracontomelum spp.</i>
WALNUT, QUEENSLAND-	AS	<i>Endiandra palmerstonii</i>
WALNUT, TROPICAL	AM	<i>Juglans spp.</i>
WAMARA	AM	<i>Swartzia spp.</i>
WATTLE, BLACK	AS	<i>Acacia mollissima</i> , SYN. <i>A. mearnsii</i>
WAWA	AF	<i>Triplochiton scleroxylon</i>
WENGE	AF	<i>Millettia spp.</i>
WEST AFRICAN CORDIA	AF	<i>Cordia millenii</i> and <i>C. platythyrsa</i>
WHITE BOMBAY	AS	<i>Terminalia procera</i>
WHITE-CEDAR	AM	<i>Tabebuia spp.</i> (White-cedar group)
WHITE CHEESEWOOD	AS	<i>Alstonia spp.</i>
WHITE CHUGLAM	AS	<i>Terminalia bialata</i>
WHITE CYPRESS-PINE	AS	<i>Callitris glauca</i> , SYN. <i>C. columellaris</i>
WHITE LAUAN	AS	<i>Pentacle contorta</i>
WHITE MERANTI	AS	<i>Shorea spp.</i> (White meranti group)
WHITE OLIVIER	AM	<i>Terminalia amazonia</i>
WHITE SERAYA	AS	<i>Parashorea spp.</i>
WHITE TABEBUIA	AM	<i>Tabebuia spp.</i> (White-cedar group)
YAGRUMO MACHO	AM	<i>Didymopanax morototoni</i>
YAHU	AM	<i>Sterculia pruriens</i>
YANG	AS	<i>Dipterocarpus spp.</i>
YAWAREDAN	AM	<i>Sclerolobium spp.</i>
YELLOW MERANTI	AS	<i>Shorea spp.</i> (Yellow meranti group)
YELLOW SANDERS	AM	<i>Buchenavia capitata</i>
YELLOW SERAYA	AS	<i>Shorea spp.</i> (Yellow meranti group)
YELLOW STERCULIA	AF	<i>Sterculia oblonga</i>
YEMERI	AM	<i>Vochysia spp.</i>
ZEBRANO	AF	<i>Microberlinia brazzavillensis</i>
ZEBRAWOOD	AF	<i>Microberlinia brazzavillensis</i>

Appendix C--List of Generic Synonyms

<i>Afrormosia elata</i>	<i>Pericopsis elata</i>	AF
<i>Brosimum guianensis</i>	<i>Piratinera guianensis</i>	AM
<i>Chrysophyllum africanum</i>	<i>Gambeya africana</i>	AF
<i>Cistanthera papaverifera</i>	<i>Nesogordonia papaverifera</i>	AF
<i>Coumarouna odorata</i>	<i>Dipteryx odorata</i>	AM
<i>Fagara flava</i>	<i>Zanthoxylum flavum</i>	AM
<i>Knema spp.</i>	<i>Myristica spp.</i>	AS
<i>Libidiba spp.</i>	<i>Caesalpinia spp.</i>	AM
<i>Payena spp.</i>	<i>Palaquium spp.</i>	AS
<i>Piptadenia spp.</i>	<i>Anadenanthera spp.</i>	AM
<i>Piptadenia africana</i>	<i>Piptadeniastrum africanum</i>	AF
<i>Prunus africanum</i>	<i>Pygeum africanum</i>	AF
<i>Samanea saman</i>	<i>Pithecellobium saman</i>	AM
<i>Sarcocephalus diderrichii</i>	<i>Nauclea diderrichii</i>	AF
<i>Tabebuia donnell-smithii</i>	<i>Cybistax donnell-smithii</i>	AM
<i>Tarrietia spp.</i>	<i>Heritiera spp.</i>	AS

Appendix D--List of Generic Groupings*

Chrysophyllum	see Cynodendron	AM
Knema	see Myristica	AS
Melanorrhoea	see Gluta	AS
Neesia	see Durio	AS
Payena spp.	see Palaquium spp.	AS
Sindora	see Pseudosindora	AS
Vatica	see Cotylelobium	AS

* More than one genus marketed under a trade name.

Appendix E--Derivation of Comparative Toughness
Values in Table II-1

Studies have been made to measure the effect of machine type, specimen size, and moisture content on toughness. Vilela^{6/} compared results using the Forest Products Laboratory (FPL) toughness testing machine and the Mohr and Federhaff pendulum impact machine (similar to the Amsler machine). Specimens were 1.6 by 1.6 by 24 centimeters long loaded over a 20-centimeter span equivalent to the 5/8- by 5/8- by 10-inch specimen loaded over an 8-inch span. Twenty tropical hardwood species with a sampling of 10 trees per species were evaluated in the green condition and at a moisture content of 12 percent.

Average toughness (Kg-M) for all species combined for each machine type tested green and dry was:

	<u>Green</u>	<u>Dry</u>
FPL machine	1.82	2.25
Amsler-type machine	1.88	1.67
FPL/Amsler	.97	1.35

Vilela did not compare the effect of specimen volume between supports. Gerhards^{7/} made such tests using the FPL machine. Six North American species were tested in the green and dry condition. There was little effect of moisture content and all toughness values combined gave a ratio of:

$$\frac{2\text{-cm}}{5/8\text{-in.}} = 1.80$$

Based on the Vilela and Gerhards results, the following conversion factors were used:

$$\begin{aligned} \text{FPL } 5/8\text{-inch green} \times 1.25 &= \text{FPL } 5/8\text{-inch dry} \\ \text{FPL } 5/8\text{-inch green} \times 1.80 &= \text{FPL 2-centimeter green} \\ \text{FPL } 5/8\text{-inch dry} \times 1.80 &= \text{FPL 2-centimeter dry} \\ \text{FPL 2-centimeter green} \times 1.00 &= \text{Amsler 2-centimeter green} \\ \text{FPL 2-centimeter dry} + 1.35 &= \text{Amsler 2-centimeter dry} \end{aligned}$$

^{6/} Vilela, J. E. 1977. Estudio comparativo de los ensayos de tenacidad realizados con dos equipos diferentes. Lab. Nac. Prod. For. Merida.

^{7/} Gerhards, C. C. 1968. Effects of type of testing equipment and specimen size on toughness of wood. U.S. Dep. Agric. For. Serv. Res. Pap. FPL 97.



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